Tenants of an Old Farm

Leaves from the Note Book of a Naturalist

Illustrations from Nature

TENANTS of an OLD FARM.
Leaves from the Note-book of a Naturalist.
P. LANDER

Tenants Of an Old Farm;

LEAVES FROM THE NOTE-BOOK OF A NATURALIST.

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WITH AN INTRODUCTION BY

SIR JOHN LUBBOCK, M.P., F.R.S., ETC.

ILLUSTRATED FROM NATURE.

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BY
HENRY C. McCOOK.

To the Memory of
MY MOTHER,
CATHARINE JULIA SHELDON McCOOK,
Whose Energy, Intelligence,
and Delicate Culture, Lofty Character,
Exalted Aims and Maternal Devotion,
added Honor to Womanhood,
and gave Her Motherhood an Imperishable Influence
and Charm,
THIS BOOK IS DEDICATED
In Grateful and Loving Homage
BY THE AUTHOR.

INTRODUCTION.

My friend Dr. McCook, already well known to naturalists for his "Natural History of the Agricultural Ants of Texas," and his work on "The Honey and Occident Ants," has recently published a volume of Natural History in a more popular form, which is about to appear in an English edition, and is anxious, though I should hardly have thought it necessary, for a few lines of introduction to English readers.

The President of the Linnæan Society* has done me the honour of asking me to perform this pleasant task. He might well have done so himself, but devolved it on me, because in "Tenants of an Old Farm" Dr. McCook deals with friends of mine,—with insects, and particularly ants, to which I have paid special attention. I have much pleasure in bearing testimony to the fidelity and skill which Dr. McCook has devoted to the study of these interesting atoms; and those who read his

* W. Carruthers, Esq., F.R.S., Keeper of the Botanical Department at the British Museum.

work may safely depend on the accuracy of what he says. I confess that, like Dr. McCook himself, I am one of those who think "that the truths of Nature are attractive enough in themselves, and need not the seasoning of fiction, even of so mild a flavour as offered by the 'Tenants.'" But both he and I are perhaps too much devoted to Natural History to be able to judge for others on this point. Moreover, as regards the attractive manner in which the book is written, English readers have much more conclusive testimony than any single opinion—and especially one which might be biassed by friendship, for they have the evidence of the wide popularity which the work has already attained in America. The title seems to me very happily chosen. It reminds us that we are not the only tenants of our farms — that the fields and hedges, woods and waters, all around us, teem with a complex, rich, and interesting life. But nature will speak only to those who listen with love and sympathy; and of this varied existence Dr. McCook has proved himself one of the most patient and loving students.

John Lubbock

AUTHOR'S PREFACE.

THE purpose of this book is to present a series of exact truths from Natural History in a popular form.

The author firmly believes that study of the structure, conditions and behavior of all created things highly tends to elevate human character. Under such conviction he consented to write a number of essays upon insect life with a particular view to his own specialties—ants and spiders. It was agreed that these essays should express the latest and best results of scientific research, and thus have a real scientific value and standing. As to form, the papers were to be adapted to the taste and understanding of lay or non-scientific readers.

This original plan was afterward so far changed, under the persuasion of friends, as to give the essays a colloquial form, introducing thereinto something of that interest which attaches to the play of various human characters.

The author is free to confess that the change was made after much hesitation on his part. Like most naturalists, he thinks that the truths of Nature are attractive enough in themselves and need not the seasoning of fiction, even of so mild a flavor as offered by the "Tenants." Moreover, he seriously distrusted

his ability to cast the natural facts at his command into any narrative form that would reasonably satisfy the just demands of literature. Nevertheless, as those whose judgment he most trusted believed that such a form would give his studies a wider circulation, a kindlier welcome, and so a larger influence, he ventured upon the proposed change.

Whatever may be the verdict on the above point pronounced by those who may read these pages, this at least should be said: the facts in Natural History here presented may be accepted as correct, or as nearly so as is allowed one who works in such a field. Most of the facts given have come under the writer's own observation. Where he has gone to other naturalists for information he has used the utmost care to be accurate. These remarks apply also to the popular superstitions concerning insects for whose expression "old Dan" and "Sary Ann" have been invented. Indeed Dan is not so much an invention as an adaptation of a real character.

The plan as originally proposed included references to all works consulted, and credit to every author cited. It is a cause of serious regret that this feature had to be dropped as obviously out of place in a scientific pastoral like the "Tenants," however proper in a series of scientific essays. All the heartier, therefore, are the thanks here rendered to the earnest, loving and laborious naturalists who have contributed by writings and word of mouth to these pages.

It only remains to be said that the numerous illustra-

tions (with a single exception) have been prepared expressly for this work, and (with very few exceptions) have been drawn from nature or after the author's sketches from nature. They are not only original—many of them presenting subjects in natural history that have never before been illustrated—but are correct, and, for the most part, artistic, although scientific verity has been the chief aim. To Mr. Edward Sheppard and Mr. Frank Stout, who made the larger part of the natural history drawings, especial recognition is due. The admirable comical adaptations of Mr. Dan Beard are, of course, *sui generis*, and are not without real value in illustrating the text which they brighten with the play of mirth. The absence of his skillful hand from the closing chapters is owing to an accident which threatened the loss of his eyesight, a calamity that happily has been averted.

In the belief that this book contains enough original observations to make it valuable to working naturalists, an index of the scientific matter has been prepared.

PHILADELPHIA, September, 1884.

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CHAPTER I.

TRANSFORMED AND TRANSFERRED.

At last the old farm-house at Highwood had a tenant. For years it had stood vacant, thanks to the conservative spirit of the owner, a wealthy rural manufacturer, who refused to lease it save on condition that all its antique style and fixtures should be maintained. Thanks, also, to the luxurious notions of American housekeepers, no acceptable tenant had yet been found willing to submit to the conditions.

With that steadiness which marks the return of uninhabited places to a state of nature, the house and its surroundings had fallen into decay. The premises were in sad contrast with the thrifty appearance of the place in the day of good Farmer Townes, who had lived in it from his infancy until death. Thus by a kind destiny Highwood was reserved for us. Very cheerfully we covenanted well and truly to preserve to the place all its primitive features. The ancestral shrines of the Lares and Penates of the old Quaker farmer and his Quaker forefathers should not be disturbed by the in-

vading family of "world's people." On the other hand, the proprietor, heart-sore over the advancing decay of his property, willing to serve a friend, and, at the same time seat him in his own near neighborhood, undertook to introduce enough modern improvements to bring into Highwood a reign of comfort and health. Therefore, we signed the lease and became the Tenants of the Old Farm.

On the first day of October we took possession. A bright, warm morning, well worthy to open the door of that month whose varied beauties and rich vitality make it the halcyon season of our American year. "Old Dan," a colored laborer, met us at the road-side gate with pleasant smile, polite bow, and a hearty "Welcome to Highwood!" The broad lane through which we drove was skirted on either side by a row of trees—on this side locusts, a favorite wood with our fathers; on the other, cherries, a canny or benevolent mingling of the useful and ornamental, for which the country-side boys had inwardly blessed the memory of Friend Townes.

Hugh Bond met us at the yard-gate. "Our farmer" we called him; our man-of-all-work he was, in fact, to be. He greeted us with a quiet "Good morning," becoming equally an independent freeman and an honest employé, and proceeded with much satisfaction to show us the "improvements" that had been wrought. They were visible enough to our eyes, but why should we recite them here? Suffice it to say the old trees near the front had been spared, but trimmed high up to

admit the sunlight to the chill stone walls; a new porch guarded the threshold, instead of its tumble-down predecessor; inside, the wainscoting had been repaired, walls neatly papered, and, finally, modern grates filled most of the wide chimney-places, a concession to the scarcity of wood and the abundance of coal. With warm carpets under foot, the household furniture in place, the pretty curtains at the square, small-paned windows, and the general air of coziness and home that filled all the house, like the odor of Mary's ointment, it was indeed a transformation. What eye could have seen through and beyond all the cheerlessness, disorder and dirt of the miserable farm-house that I looked at a month ago, the possibilities of so bright a home? Whose heart had the cunning to devise, whose hands the deftness to bring about this change?—whose but the dear housewife's, who beamed amidst it all with a face from which, for the hour, happiness and content had driven the anxiety that had stopped thereon too often during the last year? Yes, the magic wand that had summoned back the exiled fairies of home was the touch of the New Mistress of the Old Farm.

"A year of retirement and rest will restore his vigor and save him for the future."

That was the ultimatum of Doctor Hayes. Promptly the mistress assented. The master yielded to the inevitable only after a long, hard struggle. Do you wonder? An active life planted in a great city and come to the meridian of manhood, has many and strong roots. They run deep, they branch widely, they

clasp and entwine tightly a multitude of persons, objects, causes, plans. It is no light work to tear them up on sudden notice and transplant them to a rural home. But we have paid this penalty to over-work, and now for a year shall try the virtues of "vegetating." To work in the field or sleep in the house; to sit or walk or ride or recline; to keep the mind pleasantly occupied and the body in the open air; to drift on easily with time and chance, and to—wait! Such is the life which the Doctor bids me live. Well, a worse prescription perhaps might have been prepared. I shall take my medicine honestly, for, in sooth, one cannot—as with other doctors' nostrums that I wot of—throw this remedy out of the window.

CHAPTER II.

RENEWING OLD ACQUAINTANCE.

"WE are not the only tenants of this Old Farm!"

"Indeed!" said the mistress, resting the feather-brush a moment, for she was dusting the bric-a-brac upon our little parlor mantelpiece—"indeed?"

The first utterance was exclamatory, the second interrogatory, and the two together, taken with the glance cast at her spouse, expressed surprise, incredulity and inquisitiveness in due proportion and succession.

I stood at the open door, fencing out with my walking-stick our watch-dog "Dolf," who was always inclined to run into the forbidden precincts of the parlor. We were outfitted for a long walk, Dolf and I.

"It is quite true," I said, solemnly; "we are not the only tenants. There are a score—a hundred—in fact I know not how many races of inhabitants here, all to the manor born, and with a pedigree ante-dating William Penn and his charter, his treaties and his aboriginal traitors. They are the real 'original inhabitants'—the birds and beasts and flying-creeping things. I made the discovery yesterday. I am going to make the acquaintance of my fellow-tenants to-day. Good-by, my dear. Come, Dolf!"

We walked out, leaving the mistress brushing the mantelpiece, with a brightened look, for, thank God! her spouse had found at last a congenial outdoor occupation. Not a new one, however, by any means. Months afterward I learned that in the conspiracy for my health between doctor and wife there had been strong reliance upon a revival of the early tastes and pursuits of a naturalist, which had been pushed to the wall by engrossing business, to tide over a crisis, send the invalid into the health-giving fields, and hold him there content during the interval of rest.

"It was a happy moment indeed," the mistress said, "when the returning interest in your old studies, announced at our parlor door, showed me that the spirit of languor and decline had given back before a rising current of vitality. It was a red-letter morning, that, in my life, and the rainbow of hope bent above the old farm-house the livelong day."

Meanwhile, quite unconscious of the little woman's secret joys, master and dog were tramping across the meadow toward the small stream that threads the farm known as Townes' Run. The feathery grasses grew high along the banks; clumps of tall reeds stood in the little basins like squads of grenadiers; tufts of golden rod and wild asters, weeds and youngling bushes overhung the narrow channel. Yesterday I had found there, as I had carelessly strode on, the snare of a friend of other days, the Bank Argiope—*Argiope riparia*. I stooped to look and admire the comely spider hanging upon her white central shield. (Fig. 1.)

FIG. 1—ARGIOPE AND SNARE.

You do not believe, perhaps, in the sudden birth of a soul into a new passion, or its sudden palingenesis—its rebirth—into an old love and life? Nevertheless, as I kneeled in the grass before that web of silken threads, brought out in detail against the background of a black slouch hat held behind it, the old passion came back as with a bound, and seated itself in my heart. Many years before this, during a brief enforced idleness, in a moment like the present, when the body was drifting deviously before an aimless wind, a similar vision had awakened, as by a new birth, the first special love of a naturalist. Memory now recalled vividly the whole outward details of that scene, indeed my very thoughts and feelings. Was it merely a trick of mental association? When forests of black-jack oak succeed burned pines on a Jersey barren, and chestnut groves follow a spruce-clearing in the Alleghanies, botanists suggest that it is simply a return to an earlier state, permitted by a removal of the restraining conditions. Do old mental moods, long buried under other courses of thought and emotion, spring up in full force again when overlying habits are set aside? But this is a digression into the field of philosophy. We return to our meadow and the Bank Argiope.

She is among the most beautiful of our native spiders, and is our largest species of orbweavers, with the exception of the Plumefoot Nephila (*Nephila plumipes*) of the far Southern states. She is quite continental in her habitat, as I have traced her westward through Michigan, Illinois, Wisconsin, Nebraska, to the Rocky

Mountains, northward to Vermont, and southward as far as Texas and Florida. She has adapted herself to the widely-separated conditions of this immense territory without any perceptible variation in form or habit.

Let me describe her: her cephalothorax (united head and chest, or head-thorax) is robed in a beautiful silver-drab, so that thus far she has adopted the traditional color of the Society of Friends. But in the rest of her body she is not so orthodox, for the abdomen is beautifully marked with black, yellow and brown. Her eight legs are dark orange, ringed with brown and black. She has no fixed popular name, although I have heard her called the large meadow spider. She belongs to the group known as orbweavers (*Orbitelariæ*), because of the wheel-shaped geometric snare which they spin. There is a peculiarity in her snare, as it is generally formed, which at once marks it. In the centre, or hub, is woven a thick white silken oval patch, from the top of which extends upward a ribbon of like material. From beneath runs downward a zigzag cord, which resembles more closely than anything I know in natural spinning-work, the "winding-stair" up which the unhappy fly was "dragged into the dismal den," according to the plaintive school-book classic of the "Spider and the Fly." Argiope loves such sites as the reedy banks of Townes' Run, and one will often see her web swung among the tall grasses and bushes, while the occupant hangs head downward upon her central shield.

I had unfolded a light camp-stool and was seated contentedly sketching this pretty object when a light tread

18 FIG. 2.—STUDYING BANK ARGIOPE'S SNARE.

was heard in the grass, and a woman's voice saluted me. Abby Bradford is a bright New England girl, of good family, good education, good manners, and good looks withal. She had held a position under the government in Glen Mills, just beyond, where the paper used in national bank notes had been made. When that most convenient medium of exchange, the fractional currency, was so unwisely abolished, Abby's occupation was gone, but an engagement to teach Highwood district school recalled her from her Massachusetts home. After the fashion of the country-side, she must find a home in one of the rural families, and very gladly wife had welcomed her to the Old Farm. Her presence would relieve the solitude of our country-place, which was our advantage; and a kindly home with congenial friends was hers. We shall know her better by-and-by, but I may say here that we had cause often to congratulate ourselves upon the good fortune that brought the school-mistress into our family.

"What!" she said, when we had exchanged greetings, "are you sketching? I did not know that you were an artist."

"I am *not* an artist," I answered; "but necessity has forced upon me a little rude skill with the pencil. Will you see my work?" I gave her the note-book, and pointed to my subject hanging among the golden rods and grasses at our feet.

"A spider? Oh, the ugly creature!"

The young lady stepped backward a pace with this characteristic exclamation. As though to resent the

insult put upon her, the Bank Argiope began to shake her shield, commencing slowly, and waxing faster and faster in her movements until the whole web was in violent oscillation.

"See!" I said, "You have wounded the creature's vanity, or, at least, you have awakened her fears. Wait until she has quieted, then look closely and see if either her person or work is worthy of so harsh a criticism. There, the web is still now—what say you?"

"I do declare," answered the honest maiden, "it *isn't* so ugly after all, and the net is really a work of art. Certainly, I should know better than to speak lightly of any of Nature's children; but then, you know, spiders do seem an exception. Everybody fears and dislikes them."

"Yes, you doubtless speak for your race. There is perhaps no creature with which man is intimately associated that has come in for a larger share of aversion than our humble friend Arachne. Like most human prejudices, this is an undeserved and unreasonable feeling. The spider is a true philanthropist. She is, without reservation, a friend to our race, destroying noxious insects by myriads, and making in return no impost or levy upon our orchards, vineyards, cupboards or cellars. She is not the only example of unrewarded merit—of an ill name earned by a supposed ugly visage; in short, of a prophet without honor in his own country. Nor are spiders all so very ugly, as you have confessed. The fact is they have been deteriorated by too close contact with man. The house and cellar spi-

FIG. 3.—COCOON OF ARGIOPE RIPARIA.

ders, the occupants of our own homes, with which we oftenest meet, are precisely the ones least attractive to our eyes. If you will take the pains to search the flowers and shrubs, forests and ferns, you shall find that there are spiders with as fair an exterior, in point of color, at least, as more favorite animals. Even birds, be it remembered, have their buzzards and vultures; and at all events, as long as ladies will insist upon shuddering at sight of the most beautiful animal in creation—the serpent—we may feel justified in disregarding their prejudice against poor Arachne. However, when you know her better, I am sure you will like her more."

"Mr. Mayfield," cried Abby, "I must protest now! Surely you are not in earnest when you call the serpent beautiful? I might come over to your opinion as to spiders and insects, but—*snakes!* Ugh!"

"What is this?" I asked, touching a spiral bracelet upon her wrist. "A mimic silver serpent! And this?" I added, lifting the links of a gold watch-chain, coiled at her waistband. "And this?" pointing to coils of brown hair upon the back of her head. "Here is your own witness that serpentine forms, at least, are not lacking in beauty. Ladies do not decorate their persons with ugly things."

The play of mind upon Abby's face was a pleasant study as she followed these sentiments, evidently quite new and startling. The mantling cheeks and kindled brown eyes betrayed the mixed nature of her feelings—the pleased surprise of novel thought; the confusion

FIG. 4.—A BROOD OF SPIDERLINGS ON THEIR FIRST OUTING.

of a mind detecting itself in error—doubt and keen inquiry, as though the latent sophistry of my remarks were suspected but not seen. I followed up my advantage.

"Cast your eye along this little stream as it skirts yonder hill-side and pursues its winding course across the meadow. Has it not taken upon itself the external and formal limitations of your 'ugly snake'? If a poet were to speak of it as 'crawling,' or of its 'serpentine way,' would he not be borrowing terms from the snake's natural action to express his idea of beautiful form and motion? The progress of a serpent over the ground or through the water is the very ideal of free, graceful movement. Then, as to its anatomy—but, come, I must not be too fierce an iconoclast, or I shall cause a reaction in your thoughts against my animal friends, and quite spoil any good effect that I may have wrought in their behalf. This is your Saturday holiday; can you join me for one hour in a morning stroll along the run? I promise you some new and I hope agreeable acquaintances."

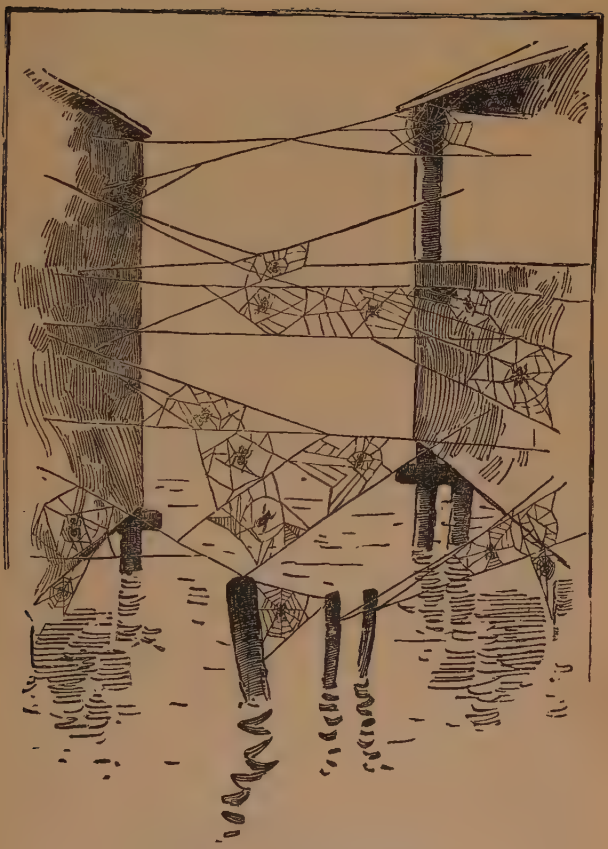


FIG. 5.—SPIDERS AT CAPE MAY.

CHAPTER III.

THE TENANTS PREPARING FOR WINTER.

"STOP! Look into this clump of grasses and tell me what you see."

"I see nothing of special interest," said the schoolmistress. "The bearded heads of the grass have been twisted together by some passing animal, I suppose, but that is all. Ah, no! I see now. Here is a beautiful little pear-shaped nest hung among the foliage. I have seen similar ones in New England, though I am sure I cannot guess what it is unless it be the cocoon of a caterpillar."

"No, it is the egg-sac, or, as it is technically called (although somewhat loosely), the 'cocoon' of our Bank Argiope. It has evidently just been made; we shall find the mother near by. Ah, here she is! Alarmed by our approach she has hidden among these leaves. Observe how the abdomen has shrunken as compared with the specimen we first saw, who was distended with eggs, which, by-and-by, she will dispose of in a like cocoon. Excuse me a moment; I must capture this little mother before telling more of her story."

Taking a paper box from my satchel I opened it, placed the two parts on opposite sides of the spider, gently approximated them until the body was inside

lightly pressed the struggling legs until they too were pulled within, then closed the box and put it in my pocket (Fig. 6.)

FIG. 6.—"COLLECTING A SPECIMEN."

"Isn't that cruel?" abruptly asked my companion, who had watched the process of "collecting a specimen" with curious eye.

"Cruel? No. I should be sorry to give needless pain to any creature; nor do I feel entitled to use my lordship over the life of the humblest insect except for a sufficient and benevolent end. As a priest in the temple of Nature I may dedicate this victim to Science. I shall see that she has a painless death. Moreover, her days are already numbered by the irrevocable decree of Nature; after the spinning of a cocoon the mother-spider hangs upon it or near it for a few days, and then dies."

"I have noticed," remarked Abby, plainly not quite satisfied that I had made out a good case, but willing to

FIG. 7.—"SCALPAGE."—(*p.* 34.)

change the subject, "that spiders are nearly always found alone. Do they never go in pairs or groups?"

"In a few species the male and female dwell together; you will sometimes see broods of younglings massed together in little balls, or seated on their webs in little clusters (Fig. 4); you will even see large colonies of adults as on the boat-houses of Atlantic City and Cape May—each on an independent web, however (Fig. 5). But as a rule Arachne, in her social habits, is the very opposite of the social ants, bees and wasps. She is a solitary body, and welcomes all visitors as the famous Buckeye wagoner, Tom Corwin, advised the Mexicans to welcome our invading army, 'with bloody hands to hospitable graves.' Nevertheless the maternal instinct is quite as strong within her as in any other animal.

"Here, now, is our Argiope's cocoon. See what a pretty shelter-tent has been made by lashing these plants together (Fig. 3). Guy ropes of silk are attached to the cocoon at various points over the surface, and at the opposite ends fastened to the foliage. Thus the tiny basket swings secure amidst the most rigorous winter storm. Our mother-spider, indeed, might sing over her cradle the famous nursery rhyme:

> "'Rock-a-by, baby, on the tree top,
> When the wind blows the cradle will rock.'

"However, there would be little likelihood in her case of such a melancholy conclusion as the lullaby has:

> "'When the bough bends the cradle will fall,
> And down comes cradle, baby and all!'

"You have doubtless heard of Indian wicker-work

water-vessels. I have seen a large woven bowl in which meats were boiled, the water having been heated by hot stones. They were perfectly water-tight. That is an admirable example of ingenuity in weaving; but Bank Argiope has approached it. The outside of her cocoon is usually tough and glazed, and effectually repels moisture. I have opened many and never found the slightest evidence that rain or snow or sleet had made an entrance. It is a strong case of forecast, certainly, although I am not prepared to say that the forecast abides in the brain-cells of the mother aranead. At all events, mother-love has met the difficulties as if they had been anticipated."

"Perhaps," suggested Abby reverently, "we are here on the track of an infinite forecast? How is the interior of the egg-sac furnished?"

"Suppose we look. We may devote this example to science and dissect it. As I open it with my knife, thus, you observe that the glaze lies upon the surface of a soft, yellow, silken plush, the whole forming the outer wall. Within that there is a mass of purple silk floss—raw silk, you might say—which evidently acts as a blanketing to the egg mass within. The eggs are yellow globules, sometimes several hundred in number, deposited underneath a plate-like cushion, and swathed with a white silken sheet. Thus the young spiderlings are snugly blanketed and tucked away awaiting their deliverance from the nursery at the coming of spring."

"But does the mother leave the little fellows there without any provison for them?"

"Well, a spider, unlike true insects, does not undergo transformation from a worm, through the chrysalid to the imago. It hatches out like a bird, and has no need to have stored within its cell a supply of nutrition as with voracious grubs. It can wait until its exode, when it is able to spin its own web and provide for its own larder. Therefore, the mother shows a true forecast of the situation and wants of her offspring when she fails to store food within the cocoon. Besides, there is a suspicion—though I am not prepared to affirm it—that the little ogres eat each other up, as necessity requires, an exigency of spider infancy which is provided for or against in the great number of eggs laid and young hatched out."

"Dear me, what a situation that for the baby spiderlings! To be shut within those inexorable walls and wait until one's turn comes to be served for dinner to one's sister or brother! It is to be hoped that Nature has kindly made the little fellows unconscious of their destiny. However, if one half is true that I hear of this human brotherhood of ours, it is not so very unlike the spider's baby-house. The big brothers eat the little ones, and the monopolies swallow all!"

"What! so young and already a cynic? But you mustn't let your moralizing blind your eyes to the facts of life all around you. Look into that bush that you are passing. I see there one of my special friends whom I want you to know. Do you find her?"

"You mean this pretty little cobweb? But it is small and delicately wrought, and half hidden among

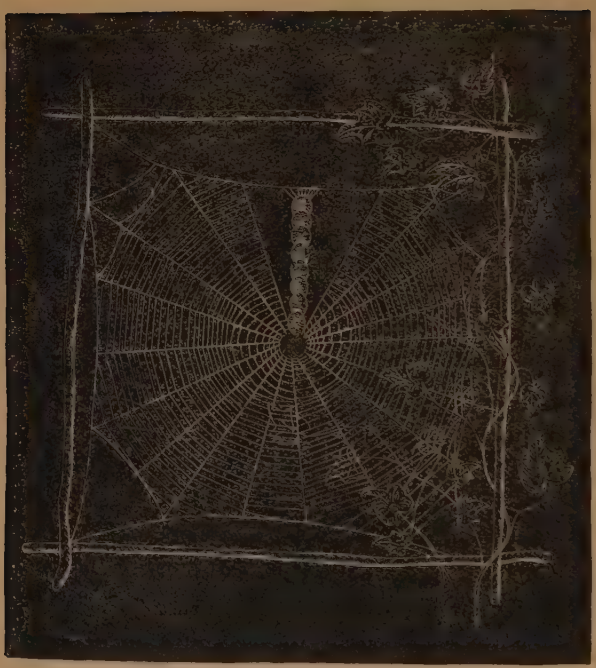


FIG. 8.—SNARE AND EGG-SACS OF CAUDATA.

the leaves. How could you see it from where you stand, eight or ten feet distant?" (Fig. 8.)

"Nothing marvelous in that. I caught the sheen of the white web in the sunlight which fell upon it just at the right angle, and a glance was enough for recognition. There is a multitude of spider webs that are revealed only thus, or on a dewy morning by the drops of moisture entangled in them. Let me show you how I

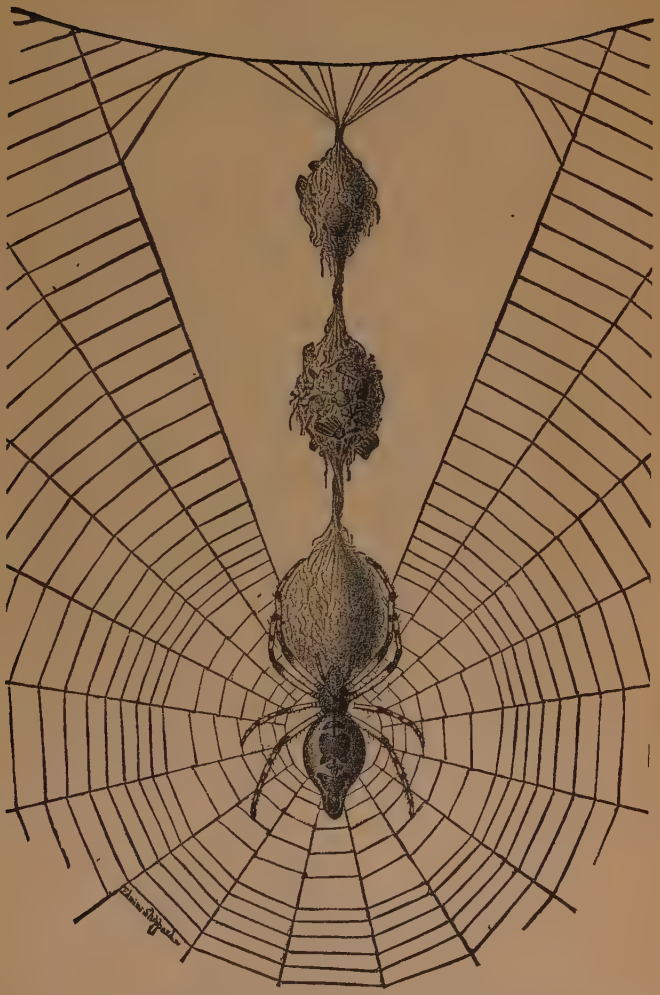


FIG. 9.—CAUDATA'S COCOONS, WITH SCALPAGE.

recognized the species. Observe that a segment of the web is quite cut out at the top, through the centre of which a thick line is stretched. This peculiarity is caused by the little mother (*Cyrtophora caudata*) when she begins making her cocoons. She cuts out the spirals, as you see, and in the clear space hangs a straw-colored, pear-shaped cocoon, no larger than a pea. At first it is a clean silken sac, but as the mother preys upon the small insects that fall into her snare, instead of casting out the dry shells, as is common, she hangs them upon her cocoon, which is soon decorated with gauze wings, shining black heads and bodies (Fig. 9) until the original color quite disappears. By-and-by a second cocoon is added; a third and a fourth follow, and I once found a string of eight. Each cocoon is treated in the same manner, until, like a genuine savage of the *genus homo*, the tiny Amazon has decorated her home and her babies' homes with the scalps of her victims. Here she hangs on the hub of her snare, holding on to the lower part of her precious string of beads with a little white ribbon woven into the net beneath her. It was this 'scalpage' that enabled me to know my small acquaintance so readily."

Leaving our aboriginal Caudata undisturbed in her wigwam to the full enjoyment of her cradles and scalps, we resumed our walk. Finding myself presently alone I turned and saw Abby intently peering into a pyramid of grasses which I had almost trodden under foot.

"Here is surely something of value," she cried. "At first I thought it was an egg-nest of Bank Argiope, but

FIG. 10.—EGG-SAC OF THE BANDED ARGIOPE.

it is quite different when I look closely. Maybe it is the work of a young mother? Ah! I see by your smile that I have blundered."

"I was thinking of your last remark; and, after all, when I reflect, it is not so unnatural a conclusion. There is Caudata, who, after having made half a dozen cocoons, might be considered an 'experienced' mother. But Argiope never makes but one. Her maternal love and energy center upon that single work, and then she dies. But upon the discovery itself I must congratulate you; it is a noble find—the cocoon of the Banded Argiope (*Argiope fasciata*)—which I have never met but once. And now, with a boast of clear-sightedness fresh upon my tongue, I have fairly run over this rare specimen! Well, it is not the first time that I have had illustration of the old adage:

> "'A raw recruit,
> Perchance, may shoot
> Great BONAPARTE!'

You have proved yourself an apt recruit in the entomological field, and have done good service. You have shown a true eye also, for this is not the egg-nest of Riparia, but of one of her congeners, the Banded Argiope (Fig. 10). Here she lies, or hangs rather, holding even in death, to the frail hammock of a few lines spun against the dry grasses. She is a beautiful creature, covered with a glossy silver-white fur coat, with bands of black and yellow across the abdomen, from which she gets her name. How fortunate! here is another snare, spun in the weeds at the edge of the run!"

FIG. 11.—SNARE OF ARGIOPE FASCIATA.

"And here is a third," echoed Abby, "with the spider hanging at the centre."

"Good! Now we can study the web, which is a very pretty object." (Fig. 11.)

"It is quite like the snare of Bank Argiope, I think—mine is at least; but yours, how daintily the central part has been decorated! Why is that?"

FIG. 12.—DECORATION OF FASCIATA.

"I cannot speak with certainty. This snare, as you remarked, resembles that of Riparia, although the central shield is rarely so prominent, and the 'winding stair' is less frequent. The decorations of which you speak are more generally found on Fasciata's nest. They are semi-circular, zigzag ribbons and cords of silk spun in pairs or triplets on either side of the hub. Sometimes they go quite around it (Fig. 12). They certainly give the snare a dainty appearance, but I imagine they are not for decoration—as the scalpage of Caudata really seems to be—but to strengthen the snare, and perhaps to form a sort of barricade to protect the owner from assault of enemies. I must collect this cocoon before we go further; it may be long before I meet another specimen. There, dead mother and her future progeny are safely boxed, and we may walk on.

CHAPTER IV.

WINTER TENANTS OF OUR TREES.

THE stream at this point entered the edge of the wood, cutting its way through by a glen or ravine, on one side of which the land rose gradually, on the other rather abruptly. Both sides were covered with bushes and a young growth of trees, whose branches spread above the run, forming in summer time a dense shade, within which and the shadow of the rocks that jutted into the stream grew numbers of tall ferns.

"On the skirts of this wood," I said, "we should find cocoons and crysalids of the Lepidoptera—moths and butterflies—in abundance. Let us search these young oak trees. I dare say we shall see something interesting." I had already caught a view of several of the objects for which we were now looking—the winter tenants of our trees—but waited for my companion to observe for herself. There is a special pleasure in the consciousness of original discovery, and a sense of personal proprietorship which adds much to the interest with which the mind regards things. One's own findings are, therefore, the most fruitful in thought, and the best texts for instruction. I had not long to wait; Abby's mind was quite intent upon the search, and soon

FIG 13 *a*.— POLYPHEMUS MOTH (FEMALE).

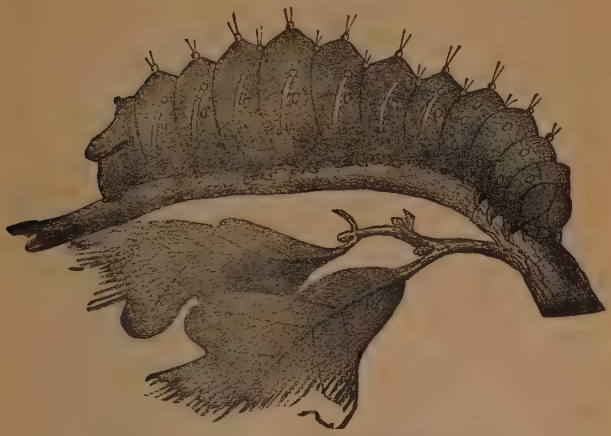


FIG. 13*b*.—LARVA OF POLYPHEMUS MOTH.

her keen eyes discerned the forms of several cocoons pendant among the branches of an oak.

"I have them!" she cried. "Curious things they are, to be sure, and a curious story, no doubt, you have to tell about them."

"Curious, certainly, to those who have thought little of such things; and yet it is only a small chapter of a great book that lies open everywhere—open, but unread. Such things as I have to tell are curious only because people have not looked into the commonest facts around them. This is the cocoon of the Polyphemus moth (Fig. 13*c*). You observe how snugly the leaves have been tucked around it. Tear them away and there appears a yellowish, oval, silken case, inside of which the pupa is stowed. The thread of which this

cocoon is spun is continuous, and easily unwound like that of the ordinary silk moth, *Bombyx mori*. It has a rich gloss, and high hopes have been entertained that it could find extensive use in commerce. A New England gentleman succeeded in rearing the insects in large numbers, so as to obtain wagon loads of cocoons. His 'plant' presented a truly animated appearance, with not less than a million worms feeding in the open air on bushes covered with a net."

FIG 13 *c*.—COCOON OF POLYPHEMUS MOTH.

"A sight more attractive to the entomologist, or silk-grower, I should think, than to the general public," remarked Abby.

"Very likely, but I have observed that a dollar discerned in the distance has a wonderful effect in brightening even a vista of caterpillars. Prospect of cash converts unreasonable sensibilities quite as quickly as a naturalist's enthusiasm. However, the general public has a deep interest in everything relating to silk culture, for although it may be a 'disgusting' fact to some minds, yet it is a fact that we owe our most beautiful habiliments to the labor, pains, and eventually the

sacrificed life of the despised silk-worm. The larva of our Polyphemus moth is thick, fleshy, striped obliquely with white on the sides, with angulated segments or 'joints,' on which are tubercles surmounted by a few soft hairs. They are hatched about the close of June from eggs laid singly by the mother moth on the under sides of leaves. Ten or twelve days intervene between the deposit of the eggs and the hatching of the larva.

"Then begins the feeding, which is not a simple eating, but a storing of food that must sustain nature during the long winter sleep, and in some cases, as with Cecropia, for example, during the life of the perfect insect when it has transformed. Not only that, but it must take in enough to supply the curious natural workshop within it with the crude material from which comes the silken fibre that furnishes its winter home. Those are busy days, therefore, for the young worm during the long summer.

"But it has periods of rest from its voracious eating. Late in the afternoon of a summer day, if you would peep among the leafy barricades of these oak-boughs, you might see our worm undergoing the tedious process of shedding its own clothes, or moulting. As the grub grows, the outer skin tightens and hardens; since it cannot yield, and as the creature must grow while it eats, the only thing to be done is to get rid of the impediment. Therefore Dame Nature, like a careful nurse, strips the young Polyphemus and puts it aside to rest awhile.

"Something analogous occurs to the human intellect

from time to time, although 'Bourbons' and 'old fogies' are said to be exempt from the process of moulting. On the other hand, there are some men who have such marvelous facility at making an intellectual moult, that one hardly knows where to find them on great questions.

"Our Polyphemus grub is content with five moults, ten days intervening between the first four, and twenty between the last two. During the intervals it resumes the serious duty of life—eating."

"How many leaves can one larva eat?" asked Abby. "It seems to me you must exaggerate its voracity, or its ravages would be more noticeable. Surely, the little creature within this case couldn't have been very formidable as a gourmand."

"Have you ever observed one at its meals? No? Well, then, you have something yet to learn as to the proportions of a healthy appetite. The hungry 'small boy' is hardly to be named for gastronomic practice beside our Polyphemus. Mr. Trouvelot, a Massachusetts observer, has determined that a grub fifty-six days old has attained 4140 times its original weight, a progress in avoirdupois which implies a corresponding vigor in table-fare. Or, to put it in another way, a full-grown larva has consumed not less than one hundred and twenty oak-leaves, weighing three-fourths of a pound, besides the water which it has drunk. Thus the food which it has taken in fifty-six days equals in weight *eighty-six thousand times* the primitive weight of the worm! You may imagine the destruction of leaves

FIG. 14.—DAME NATURE STRIPS YOUNG POLYPHEMUS FOR REST.

which this single species of insect could make if only a hundredth part of the eggs came to maturity. A few years would suffice for the propagation of a number large enough to devour all the leaves of our forests."

"But you have not told me yet how the caterpillar eats itself within this cocoon. I feel very much as the somewhat under-wise and stuttering King of England, George II., is said to have felt when he first saw an apple-dumpling. 'P-p-pray, wh-wh-where, where got the apple in?' How got the pupa inside this case?"

"You understand, of course," I replied, "that this hard and apparently lifeless object (Fig. 15) which we call a pupa did nothing to inclose itself. The larva 'got' itself 'in,' and then became a pupa. A few days before it had been seized by a strange restlessness; it wandered about uneasily; it refused to eat. What vision of its coming change had Nature given the worm? I believe human beings also are sometimes impressed in some such way before great crises. I have myself experienced, on the approach of such occasions, those indefinable, restless sensations which the moth larva *seems* to exhibit. Its first step toward forming a cocoon, after a site had been chosen, was to wrap the stem, as you see here, and lash it to the twig above. Then, sinking to this point, it gradually drew around it the adjacent leaves, making a tiny arbor or cell, which you observe is the framework of the cocoon. Within this it began to spin, drawing its silken threads from point to point as it moved around the cell. Layer succeeded layer, each overlapping its predecessor, until the grub was quite shut in, and, finally, this silken case was completed. It then ceased work, and, yielding to the strange drowsy spell which Nature casts upon its kind, it fell into this

FIG. 15.—PUPA OF POLYPHEMUS.

pupal state, wherein it will remain until late in May or early June next, when it will emerge as a perfect insect."

"Well, well," exclaimed Abby; "it is an 'oft told tale,' but it seems more wonderful to me to-day than ever before. Of course it is a ridiculous fancy; but do you know I can't help wondering if the moth knows itself when it emerges! I mean, does it have any recollection of its larval and pupal estate? What do you think? It's a foolish notion, I daresay!"

"Not at all; others have had the same thought. But who can say? Perhaps when *we* have passed through some such transformation, we may have more light on this and other of Nature's mysteries; but until then we must be content to guess at the possible experience of a moth. All we can say is that the mother insect always comes to the tree, whether oak or maple, on which it was reared as a larva to deposit her eggs. Possibly the ghost of a faint impression of the acrid flavor of oak-leaf may haunt the pairs of nervous ganglia that serve for brains in a Polyphemus, and so may urge the creature to haunt its larval resorts. One would think, however, that all sense of its old personality had been buried and left in this pupal sarcophagus. But then, again, who knows? We might as well call the mental processes of both grub and imago *instinct*, and pass on."

"I have another question," said the schoolma'am. "You see I am moved by *my* ancestral traditions, if the moth is not, and ask questions like a genuine

FIG. 16.—CECROPIA MOTH (PLATYSAMIA CECROPIA).

Yankee. Where are the spinning organs of the larva? The spider has hers, I know, at the apex of the abdomen, in several little mammals or spinnerets. How is it with the caterpillar?"

"The position of the spinning organs is precisely reversed in the silk-worm. The silk glands consist of two long, flexuous, thick-walled sacs situated on the sides of the body, and opening by a common orifice on the under-lip, or labium, usually at the end of a short tubular protuberance. They are most developed just when they are most needed—when the larva approaches the pupa state. And now, suppose we dismiss our Polyphemus and turn to others quite as——"

"There, excuse me; you have reminded me of something I wanted to ask. Why is this moth called 'Polyphemus?' Is it such a horrible one-eyed ogre as the giant who handled so roughly the great Ulysses and his companions?"

"I am afraid that I cannot fully satisfy you until we return to the house and show you a figure of the insect—possibly not then, for scientific names are not always readily accounted for. But we shall have better opportunity by-and-by, as we walk homeward, to talk over this matter of scientific names. Meanwhile, let us examine these elder-bushes along the fence-side. I hope to find an old friend—ah, there you have it, I see. It is the Cecropia moth—*Platysamia cecropia*. It has nearly the same habits as the Polyphemus; indeed, the story of that insect's life will stand, with a few variations, for all. Elder, willow and maple are the favorite

food-trees of Cecropia—in our neighborhood, at least. There is a clump of young spicewood trees, and yonder are some sassafras saplings. Let us examine them. What have you found ?"

"Here is a cluster of seven or eight hanging near together! They are long, tapering cocoons, prettily rolled in leaves and bound to the twigs by beautifully wrapped silk. See, in this one the coil extends several inches up the stem and around the twig. What is the use of all this precaution ? Wouldn't the insects come out on the ground quite as well ? Indeed, I should think that it would be colder up there exposed to wind, rain, hail, snow, and frost, than down among the dry grass and leaves."

"The question of temperature hasn't so much to do with the matter, I imagine ; the pupæ stand an intense degree of cold, even those of the butterflies (Fig. 17) which are usually naked. These have been kept in an ice-house for two years, and when removed to a warm place came out all right. Cold and damp weather retards the process of transformation ; but the cocoons do well enough on the ground where they fall, as many do ; although, on the whole, I think they are better on the branches, certainly they are safe there from the trampling feet of cattle."

FIG. 17.—PUPA OF BUTTERFLY VANESSA.

However, there are, no doubt, wise reasons for what you have aptly styled all this precaution, some of which

I can suggest. For one thing, cocoons temper the rapid changes in the atmospheric temperature. A long, steadily cold winter seems to be less destructive to the enclosed pupæ than a very changeable one of a lower average temperature. Hence the value, in a changeable climate, of such enswathments as help to graduate the weather variations.

Then, again, cocoons are of use in preventing the loss of moisture by pupæ. For example, the pupa of a Cecropia or Polyphemus moth exposed to the atmosphere without its natural covering will, as a rule, dry up or produce an imago which will not have moisture enough in its tissues to properly expand its wings.

Once more, cocoons conceal the inmates from their natural enemies. If they be noticed they are seen not to be edible, and the tough parchment enswathment protects from any but a deliberate and vigorous siege. Moreover, the odor of the pupa, by which many enemies would be attracted to it, is probably largely confined within the cocoon by their structure. You must take my suggestions with some allowance, however. I confess that I am not in a position to be very positive upon this interesting query, which involves some puzzling and seemingly inconsistent facts. But to return to our Cynthia cocoons, let me call your attention again to the manner in which the larva has wrapped the leaf-stalks entirely around and carried the windings clear up to the twig on which the leaves hang. One is almost led to think that the worm wrought with some knowledge that leaves have the habit of dropping

from the trees, and secured itself against any such accident by lashing the petiole tightly to the limb."

"Well—but—surely, you don't thing that the worm really did know *that?*" exclaimed Abby.

As I did not venture upon an answer, somewhat fearing the questions that the quick-witted maiden might shower upon me, the schoolma'am dropped the matter and started another query.

"Why should these cocoons be swung aloft in this fashion, instead of being tied directly to the limbs? Does the pensile condition give them any special protection?"

"That is partly, perhaps mainly, due to the peculiar character of a sassafras leaf-stalk, which you can readily observe. Yet I can suggest one probable advantage. There is a cousin-german of these specimens—*Samia cynthia*—who usually builds upon the ailanthus tree. I have gathered a brood of twenty-three cocoons hanging upon a small branch. The ailanthus leaf, you know, falls early, and you may observe the cocoons (Fig. 18) pendant in clusters from the bare boughs of the trees along our city streets. I have seen the sparrows pecking at them, and was reminded of the days when I tried to gain health and muscle by a daily boxing-match with a sand-bag hung in the back yard. Of course the bag swung away at every blow, only to come back again. I never had any damage from the sand-bag, which, I suppose, was the main point; but, on the other hand, the sand-bag never got any damage from me, simply because it

FIG. 18.—CLUSTER OF CYNTHIA COCOONS.

wouldn't stay to get it. That was precisely the case with the ailanthus cocoons; they gave way before the bills of the mischievous, chattering sparrows, who could, therefore, make no impression on them. Those cocoons were even more carefully attached than these of the Prometheus, the twigs on which they hung being wrapped for ten and twelve inches from the stem, which was also carefully bound about with a quite decided ribbon of fine yellowish white silk. The leaves and leaf-stalk were tightly wrapped to the twig, and thus all were carefully suspended aloft, where they hung through the entire winter. Now, I do not know from actual observation that the sparrows wished to tear open the cocoon for the sake of the contents, but I have thought that, in early spring, at least, their motive may have been to get material for their nests."

"Why should the sparrows wish to obtain the contents of a cocoon?" asked Abby. "Could they eat the pupa?"

"That they could, for the pupa is little more than a mass of vital juices, contained within a not very tough crust. I have said that I have no positive evidence to convict our English sparrows of preying upon the Cecropia pupæ, but I cannot say as much for some other birds. There is at least one bird, the hairy woodpecker (*Picus villosus* Linn.), from whose beak the staunch cocoon of the Cecropia offers no protection whatever.

"I have noticed one of these birds, during the early

FIG. 19.—THE SPARROW'S SPARRING PRACTICE.—*p.* 52

months of winter, clinging to a twig, pecking away at the parchment-like covering of a cocoon attached thereto in a manner that amused me very much, and I was hugely enjoying its (as I supposed) vain attempts to penetrate it. But when it hopped to an adjoining limb, shook itself and exhibited the well-known natural

behavior of a bird that has just banqueted, I began to think its powers had been vastly underestimated. By the aid of a ladder the cocoon was obtained and found not only to have been punctured, but all the soft and liquid parts extracted. As there were other cocoons attached to the same tree which, upon examination, proved to be uninjured, I was led to believe the bird had found a weak part in the one which it had penetrated.

"After a few days another cocoon was found to be punctured, this time fairly upon the crown and apparently in the strongest part. I now saw what had before escaped my notice, viz.: that by the situation of the first cocoon it was accessible to the bird only from below, which accounted for the puncture being near its base, close to the twig. A short time afterward, on passing another tree, out from among the branches flew the little murderer, and, as usual, a pierced cocoon was found, the puncture yet wet with the juices of the pupa, showing that I had surprised the bird while at breakfast.

"In the month of January in the succeeding year, I again found the winged destroyers at work, and could easily distinguish the dry, rattling sound, the death knell of the beautiful moth, the larva of which seems to be as destructive to vegetation as the imago is innocent. So far as I have been able to observe, the birds do not attack these cocoons until winter, when other insect food is not so easily obtainable. In fact, this seems to be a source of subsistence stored up for this

season of the year, always fresh, and, to all appearances, at all times available."*

"But, even if we should acquit the sparrows of murderous intent in their assaults upon cocoons, we may fairly conjecture that they are influenced by desire to gather material for nest-building.

"I have specimens of the nests of a Vireo taken in Fairmount Park, which are largely constructed of silk stolen from cocoons and webs of spiders. One may imagine the vigorous but unavailing protests of the despoiled spinster against the rape of her fair silken yarns, but what could she do against the thieving birds? Her stationary domicile and cocoon were far more exposed to the winged robbers than the oscillating house of the moth, pendant from the trees.

"But we have quite spent our hour afield. We will walk homeward through the ravine, and collect such specimens as we may on the way. I dare say we shall find enough material to supply a theme of conversation for a pleasant evening at home."

"You promised to initiate me into the mysteries of scientific names when we started homeward," said Abby; "cannot your fulfill your promise now?"

"There is not much mystery in the matter," I replied, "and I shall have little difficulty, I think, in

[* Among the many letters called out by the original chapters of "The Tenants," as published in THE CONTINENT, was one from Mr. F. M. Webster, Assistant Entomologist of the State of Illinois, who forwarded me the above facts concerning the hairy woodpecker, as observed by him, and printed in the *American Naturalist*. They are confirmatory of my allusion to the sparrows, and I here take the liberty of adding them to the Tenant's Experience.]

introducing so apt a candidate as yourself. The fact is, objects in natural history are named precisely on the same principle that prevails in the bestowment of individual names among men. An animal or plant has a *generic* name that corresponds with the gens, sir, or family cognomen of a man, and a *specific* name that corresponds with his baptismal, Christian, or individual name. There is this difference, that the order of the names is reversed, the gens name of an animal being placed first instead of last. However, there are some nations, as the Hungarians and, I believe, also the Chinese, who follow the very order that naturalists have established; and in our directories, ledgers and other lists of names we Americans do the same. Thus you might see your own gens or family name, *Bradford*, preceding your individual name *Abby*, and so on through all your clan. If you were to write such a list and a list of insects in opposite columns you would at once see the analogy, thus:

"Bradford, Abby,	*Argiope riparia*,
Bradford, George,	*Argiope fasciata*,
Bradford, Mary,	*Bombyx mori*,
Bradford, John,	*Telea polyphemus*.

"That is a simple enough arrangement, and naturalists invariably adhere to the rule to give only the two necessary names to one animal. Certainly, some of their titles are sufficiently formidable (chiefly because they are new to us), but you will now never see any multiplication of scientific names upon one poor little creature such as many human babies are com-

FIG. 20.—THE RAPE OF THE YARNS.—*p.* 57.

pelled to receive: *Angelina Seraphima Celestiana Jane-Eliza* BROWN! In sooth, scientific nomenclature is not the greatest offender in the matter of long and sounding titles."

"Where do the naturalists get their names?" asked Abby, after heartily enjoying my sally, which her experience with the names of her school-children enabled her to fully appreciate.

"The rule is to derive the generic name from the Greek, and the specific name from the Latin, or to convert the former into a Greek form and Latinize the latter. It is further the custom, which is not, however, invariable, to construct the names from some marked characteristic of the animal. Take, for example, our spider friend *Argiope riparia*. The generic name is taken from mythology, after a fancy that long prevailed among naturalists, and which is especially marked in the science of astronomy, as you will see by recalling the names of the planets. Argiope (*Αργιόπη*) was a Greek nymph, and the fancy of the araneologist who created the genus led him to give her name to it. The specific name *riparia* was given by Hentz to our fine species, because he frequently found the creature along the banks of streams, and *riparia* is the Latin adjective that describes this fact. In the same way the other beautiful species was named *Argiope*, of course, because she belongs to the same genus, and *fasciata* (Latin for *banded*) because of the black bands or stripes laid over her silvery abdomen.

"Take the next example on our list; the scientific

name of the silkworn is *Bombyx mori*. The generic title is simply the Greek name for that insect (*βόμβυξ*, *bombyx*), which very properly is given to the genus of which it is the best known member. In other words, like distinguished sovereigns and citizens it established a 'house' bearing its own name. The specific name *mori* is the genitive case of the Latin word *morum*, a mulberry, and those who have ever fed silkworms can see the reason for such a title for that individual member of the 'house' of Bombyx.

"Now as to *polyphenus;* its specific name was probably given, as you guessed at first, because, at the time of its discovery, it was supposed to be the giant among the moths; or, perhaps, because of the large eye which marks each wing of the perfect insect. Specific names are often given in honor of naturalists or others whom the naturalist wishes to compliment. For instance, I might be pleased to name some spider or bug after my friend Bradford, in which case I should Latinize the termination, and call it *Bradfordii*, or if after Miss Abby herself, *Bradfordiæ*, perhaps, which is the female termination of the Latinized *Bradfordius*. Such are the general rules governing scientific nomenclature. There are exceptions and violations. But here we are at home!"

"Thanks!" said the schoolma'am. "I see now what I never knew before, that in science, at least, there *is* much in a name."

CHAPTER V.

MOTHS AT THE FIRESIDE.

"THERE is a peculiar pleasure in the hearth when the first autumnal frosts call for fires. That is, if one has an open grate or an old-fashioned fireplace. Modern stoves and furnaces have burned all the poetry out of the songs and traditions of the 'fireside.'

"It requires a more vivid imagination than ordinary mortals are blessed with to throw the charm of 'ingle-side,' and all that, around a hole in the wall covered by an iron filagree gate through whose perforations a hot air-blast is puffing. As to stoves, if we except the good old 'Franklin,' and all of that ilk, there is nothing to be said about or for them save that they do 'keep us warm.'"

So the Mistress discoursed as Dan piled up the hickory-wood upon the great back-log already smoldering upon the sitting-room hearth. In the general repairs which the old farmhouse had undergone this room was preserved from the intrusion of a coal-grate, and its cavernous depth dedicated to the ancient Lar of the and-iron and crane. Behold us, then, the entire Highwood family, seated before the first fire of the season, rejoicing in its genial light and warmth. The specimens gathered

FIG. 21.—COCOON OF CECROPIA MOTH.

in the morning walk are laid upon the table, together with divers books of reference. The Mistress, the schoolma'am and myself have seats at the table; Hugh Bond, the farmer, sits at the chimney side; at his feet sits his youngest boy, Harry, and opposite him are his son Joe, a stout lad of seventeen, and his daughter Jenny, a young woman of nineteen, who is established at Highwood as one of our handmaids. Old Dan, somewhat more modestly, sits on a cricket at the side of the door that opens into the kitchen.

In the days of Farmer Townes the room in which we sit was the "living-room" of the family, the kitchen serving for the dining-room as well. We have made the best of the builder's plans, and converted it into a dining and sitting-room jointly and severally. A snug and comfortable place it is, too, with its great wood fire roaring in the chimney!

We are a democratic company, observe, and why not? for we are gathered for the study of natural science, and science knows no caste; besides it is the good wife's doing, and came about in this wise:

The advent of the master and schoolma'am, as they entered the gate after their morning walk, with hands full of divers specimens and others fluttering from the master's hatband, had created quite a sensation at Highwood. It was midday, the dinner-hour on an American farm, a custom come of descent doubtless from the European "déjeûner," with which meal, at least, both in character and time, as now served upon the Continent, it precisely corresponds. The entire

household was therefore on the premises, and were all on the alert to know what such strange procedure might portend. Dan shook his head significantly, and evidently considered it a natural outcropping of my malady. Sarah, the cook, thought that "yarbs" for medicine might be at the bottom of the business, until Hugh explained that something more than plants had been carried home. He had a faint glimmer of the facts, for some one had told him that his "boss used to be a great bug-hunter." Joe, Jenny and their little brother Harry, a bright twelve-year-old boy, with that strong sympathy with nature which marks young people, were full of curiosity which (with Harry especially) overflowed in a very freshet of questions. The Mistress had noted all these things as she moved back and forth, and at her request an invitation was carried to the whole domestic company to join the evening conversation. All accepted heartily except Sarah, a middle-aged white woman, childless and a "grass-widow," who declared that she "didn't see no use in any sich nonsense." Nevertheless, as she sat in the shadows beside the kitchen-stove she cast many surreptitious looks through the open door upon the group at the table, and kept a wide-open ear turned in the same direction.

"Suppose you begin the conversation," said Abby, "by telling us the use of these cocoons. What ends do they serve in nature? I was much interested in your statements this morning, and would like our circle to have the benefit of some of them at least."

"Very good. I will answer by first asking Bond a question: What is the use of the straw coverings which you were wrapping around the rose-bushes this morning?"

"Why, sir," replied Hugh, smiling at such an apparently simple question, "that's plain enough. It saves the bushes from the frost."

"But surely the frost gets through the straw at last, and the bushes must be quite as cold during winter as the outside atmosphere?"

"Y-a-a-s," Hugh returned; "but then the straw kind o' tempers it, too. You see, the cold works in gradual like, and allows the plant to git used to it. Besides that, I've been told that the bushes 'sweat' jist like animals, and the heavy straw swathing keeps in that nateral warmth. Still, I don't know 'bout that. I reckon the rabbits has somethin' to do with the business, too; leastways, I take pretty good care to wrap the lower parts a leetle closter. But, to tell the truth, sir, I never thought much about the why and wherefore. I puts a coat on the tender bushes pretty much as I puts one on myself."

"Well, Hugh, you have given a good enough starting point for my answer. The cocoons, like the straw wraps, temper the rapid changes in the atmosphere. A long, steady winter seems to be less destructive to the inclosed pupa than a very changeable one of a higher average temperature. Hence the value, in a changeable climate, of such wraps as help to graduate the weather variations. Here now is this Cecropia cocoon.

FIG. 22.—CECROPIA COCOON PARTLY DISSECTED.

(Fig. 21). I strip aside the leafy covering, and expose a stiff, parchment-like case, as waterproof as a rubber-coat. Inside, you see an egg-shaped object, completely covered with a thick blanketing of flossy silk. (Fig. 22). The silk overlays a second parchment case, which I cut away, and come to the baby moth, tucked in its cradle, sound asleep. This is what we call the *pupa*. There it is!"

The whole party had eagerly watched the progress of the scissors as I dissected the cocoon, and the young people had become so much interested that they left their seats at the fireside, and approached the table.

"Dear me!" said the Mistress, laughing, "that quite equals the care which German mothers give their babies in winter. I have seen them lying upon a feather bed, and another bed of eider down or feathers laid upon them as a covering. Their rosy little fat faces peeped out of their knit woolen caps, and showed pink and chubby like a premium peach in a bunch of cotton."

"I wonder," said Abby, "if the Indian mothers didn't get their style of wrapping up their papooses from the Cecropia moth?"

"Who knows? Dame Nature has given many a good hint to men, and the squaws might have gone further and fared worse. But to proceed with our lesson: here is one of Harry's contributions. He dug it out of the potato-field for me this afternoon. I didn't give him the name of the baby insect, or I fear that he would not have been so friendly toward the 'poor wee thing,' for it is an old acquaintance—'the potato-worm.'"

FIG. 23.—THE POTATO-WORM LARVA OF S. QUINQUE-MACULATA.

"Hi!" cried Dan, sitting bolt upright on his cricket, "doan' mean ter say, Mars Mayfiel', dat *dat's* de nas'y big green catumpill'r 't eats de tater wines? 'Taint nothin' like it, shore!"

"Yes, Dan, this is the potato-worm, the tomato-worm, or the tobacco-worm, just as you choose to call it. You all know it—a large green caterpillar, with a kind of thorn on the tail, and oblique, whitish stripes on the side of the body. It grows to the thickness of the fore-finger, and the length of three inches or more (Fig. 23). It comes to its full size from the middle of August to the first of September, then crawls down the stem of the plant, and buries itself in the ground.

There, in a few days, it throws off its caterpillar skin, and becomes this bright brown crysalis." (Fig. 24).

"If you please, Mars Mayfiel'," interrupted Dan, "whar's de 'coon? Dat's no 'coon at all; I 'speck

FIG. 24.—PUPA OF POTATO-MOTH.

Harry's done shucked it, and I'd like powerful well to know all 'bout dat tater-worm."

"I didn't neither!" answered Harry, warmly. "That's all there was of it; Mr. Mayfield stood by while I dug, and knows it's so."

"Quite true, Harry; but, Dan, can you tell why Bond don't wrap up the *roots* of his bushes in straw, as well as the branches?"

"Why, Mars Mayfiel', 'v course de ground keeps de roots warm widout de straw."

"Precisely; and so it is with the crysalis. As the larva goes into the ground, to 'transform,' as we say, instead of hanging on the tree like this Cecropia, it has less need of the protection of a cocoon. Although we shall see by-and-by, that crysalids can get on very well, even when hanging naked on the trees.

"But look at this," said Abby, pointing to the long, stem-like appendage at one end of the crysalis. "Your crysalis must have been suspended to the trees at some

time, for here is the very stem by which it hung, just like those of the Polyphemus and Cynthia moths." Thereupon she handed the object to the mistress, who examined it carefully.

"Why, father," she remarked, "I fear that Abby has caught you napping this time."

"That is right," I answered. "I am glad that your minds are alert and not disposed to take too much without question. Let the crysalis pass around the circle, and then I will show you the imago or perfect insect. Here is a figure of our potato-worm full fledged. A fine large moth it is, you see. It has dropped its humble name now and is known as *Sphinx quinque-maculata*, or, in plain English, the Five-spotted Sphinx." (Fig. 25.)

"Well, well," said the Mistress, a little impatiently. "What has that to do with this 'stem' that we were talking about?"

"Patience, my dear, I am coming to that; but I want you, first, to see the insect's tongue. Come, Abby, you have the first look; do you see the tongue?"

"Not I! and it's not to be seen, for the back of the moth is toward us."

"Then let the others try."

All studied the picture and came to the same conclusion—no tongue was to be seen.

"I must put spectacles on your eyes, I find. You see this long, delicate, curled organ rising out of the head and extended over the flower into which it is about to be thrust?—this is the insect's tongue."

FIG. 25.—SPHINX QUINQUE-MACULATA.

"*That* the tongue?"

"The tongue?"

"The tongue!"

So the query and exclamation ran from one to another, or, rather, rose from all in chorus.

"Yes," I answered, "that is the tongue, and Madam Sphinx certainly can't complain of its brevity. Here, now, is where your 'stem' comes in. The long, slender object which you mistook for the cord by which a cocoon hangs is a *tongue-case*. It is bent over, as you see, from the head so as to touch the breast only at the end, causing the crysalis somewhat to resemble a pitcher."

My discourse was here interrupted by an unctuous roll of laughter proceeding from the kitchen door, "Ho, ho, ho!"

All eyes were turned upon Dan, who was rocking back and forth upon his stool, in an ecstacy of merriment. Soon the entire group was laughing in pure sympathy, for no one had suspected the cause of Dan's mirth.

"Beg pardon, Mars Mayfiel'," he said, at length. "I done forgot my manners, dat's a fac'; but it come over me so sudden! I'se jes' thinkin' dat ef all de long-tongued folkses could git dat kin' uv a spectakle-case to stow away dar tongues in, 't would be mighty handy round our kitchen o' nights! Dar's Sarey Ann, now, ——"

Another outbreak of hearty laughter interrupted Dan's remarks, the point of which every one appre-

ciated; for, with all her excellencies, our cook carried a sharp tongue, and was prone to use it freely, as Dan had more than once complained, upon "de kitchen folks."

"Dan Davis," cried a wrathful voice from out the shadows of the kitchen, "you'd better curl up a rod or two of your own tongue, I reckon."

Dan hitched his cricket around, half rose, and looked into the kitchen. "'Fore goodness sake, Sarey Ann, I nebber s'posed you's a lestenin' to our nonsenses 'bout the bugs. Hi den! You've been keepin' the lef' year open all de time?"

"Sit down, Dan," I said. "I'll intercede for you with Sarah, although you certainly deserve a little tongue-lashing this time. Let us get back to our crysalis. It remains in the ground through the winter, below the reach of frost, and in the following spring the crysalis-skin bursts open, the large moth crawls out of it, comes to the surface of the ground, and, mounting upon some neighboring plant, waits until the approach of evening invites it to expand its untried wings and fly in search of food, which it sucks from the flowers by means of its tongue. The tongue can be unrolled to the length of five or six inches, but, when not in use, is coiled like a watch-spring, and is almost entirely concealed between two large and thick feelers, under the head. The moth measures across the wings about five inches; is of a gray color, variegated with blackish lines and bands, and on each side of the body there are five round, or rectangular, orange-colored spots en-

circled with black. These are the markings that have given it the name of the Five-spotted Sphinx."

"Why should it be called a sphinx at all?" asked Abby.

"The larva, when disturbed, has the habit of raising its head aloft and curving several of the first segments of the body (see Fig. 23). The fancied resemblance of this attitude to the Egyptian Sphinx has suggested its scientific name."

"That is very good," said the Mistress, "very good, indeed, and I am sure that it will help me to remember what you have said. Is that what has been called a scientific use of the imagination? If so, I suppose we might complete the fancy, and think of the famous 'Riddle of the Sphinx,' as the continually repeated question of the farmers, 'What be them worms made for, anyhow?'"

"Are not these large moths very rare insects?" asked Abby. "I don't remember ever to have seen one."

"On the contrary, they are quite common," I replied. "You will find them even within the city limits, where they feed on the Jimson (Jamestown) weed, which grows abundantly on vacant lots. But they are night-feeders, keeping close under the cover of the leaves and branches during the day, and only flying abroad after nightfall. For this reason we rarely see them. You have seen the small species of moths fluttering around the lights on a summer evening, but the large species do not often venture through the windows. The fact is, there is a night-world of all sorts of creatures living

FIG. 26.— THE RIDDLE OF THE SPHINX.—*p.* 75.

close around us, little known by most men, and, indeed, their presence little suspected."

"It's a mighty good thing," remarked Dan, "dat dem mo'hvs *doan* fly inter de winders often." He placed his elbows on his knees, leaned forward, rested his chin upon his fists, shook his head oracularly, and assumed a very solemn air. "No, it ain't bes', noways, to have too much to do wid dem critters. Dar was my brudder Wash, 'fore I cum up from ole Marylan'; de berry week 'fore he died one ob dese big mo'hvs flew inter de winder, flickered aroun' de candle, and 'fore we know'd brushed it right out. Dar we wur, all in the dark; an' I tell you, a fearder set there never was. I 'member dat night to dis day! We knowed we was warned, an' dat some 'v us mus' go. But which?—Good Lor', *dat* was de question! Shore 'nough, a week arter dat, Wash was taken sick an' died. He knowed he had to go w'en he was tuk, an' jis lay down and kin' o' faded out. No! It doan do to have too much to do wid dem mo'hvs.

"An' dat ain't all," continued the venerable servant, perceiving that we were all encouraging him to continue his discourse. "Dat ain't all, needer. Dar's one ob dem mo'hvs dat goes flyin' roun' wid a reg'lar raw-head-and-bloody-bones on it, like de pirate flag ob Captain Kidd. Dey calls it de 'Death's-Head Mohf,' or somethin' like that——"

"Did you ever see one, Dan?" I asked, interrupting him.

The old man started, spread his open palms upward,

rolled his eyes, shook his head, and, with a voice that almost trembled with fear, replied:

"See one, did you say? Doan nebber ask dat question, Mars Mayfiel'. Ob course, I nebber did! De good Lor' 'n mercy forbid dat! Amen. Why, it's all a man's life's worth to see a Death's-Head Mohf. Mor' 'n dat"—here he lowered his voice to a deep whisper—"dey do say dat the good Lor' He nebber made dat critter at all! De ebil sperrits—de berry ole debbil heself—'ceived de idee, an' fabricated dat ting in de darkest night ob de year. Doan tell me! I doan want to see no *sech* doin's. Doan you show me dem picters, needer. No good luck 'll ebber come from paintin' dem tings. How d'ye suppose de man dat drawed 'em ebber libbed to do it widout some powerful conjurin' and cahoots wid de ebil sperrits? Dar's bad work about dem books, I'se afeared." He pointed to the work on natural history that lay on the table, open at a page whereon several moths were figured.

"An' that's as true as preachin'!"

It was Sarah's voice that broke the silence that followed Dan's discourse, which found credulous hearers among a good majority of our company. The cook had gradually hitched her chair nearer and nearer to the door, until, quite unable to withstand the fascination of Dan's superstitious remarks, as he lowered his voice she rose from her seat and now stood in the doorway. Her face was flushed with excitement, was wrought up into an expression of terror, and as she spoke she stretched out her arms like a prophetess.

FIG. 27.—THE SHADOW OF A MOTH.—*p.* 77.

"Dan never said truer words, though he isn't overstocked with sense, for that matter. There's bad luck in them moths any way you take 'em. I never 'low a caterpillar to git into the house, and I wouldn't for the world. I tell you, I run for the broom quicker when I see one a-coming. Why, if it spins its nasty cocoon in the house it's a sure sign that death'll come, and no tellin' who'll be taken. If it gits in your clothes-press, or anywhere, and spins on your dress, it's a certain warnin' that you'll wear a shroud before the year's out. I've heerd that often, and jest know it's true. I don't like all them things that Mr. Mayfield has brought into the house, an' I told 'im so, too! There, I've said my say!"

Whereupon the good woman again retired to the shade of the kitchen-stove.

I glanced around the circle, and observed that the countenances of my little audience showed varied emotions. A mingled expression of amusement and disapprobation sat upon the face of the Mistress; evidently her ideas of domestic discipline had received somewhat of a shock. Abby could scarcely suppress the laughter that played around her lips. As for the rest, they looked perplexed and sober, and it was easily seen that the superstitions of Dan and Sarah had disturbed them. Of course, I could not let the matter pass without some explanation, and, as though divining my purpose, the mistress disposed of Sarah by sending her into the cellar for cider and apples.

"We have been very fortunate this evening," I

began, "in having living examples of the queer notions which many people have formed about these poor moths. Of course, they are mere superstitions, and very absurd. You needn't shake your head, Dan, it is quite true; I shan't try to straighten out such an old fellow as you, but we mustn't let these young people fall into any such foolish beliefs. In earlier times people knew so little about natural history, and were so filled with superstition generally, that they conceived all manner of ridiculous ideas of the living things around them, and their relations to man and his destiny. We have learned better now; we know these birds, and beasts, and creeping things quite well; for naturalists have studied their habits, and have interpreted, in a simple and natural way, many of the strange sounds and sights that filled our forefathers with awe. Let us dismiss all such idle fancies."

"But what is this story of Dan's, about the Death's-Head Moth?" asked Abby. "I have heard something of that kind before."

"Here is the insect," I answered, turning to a figure in the book before us. "These white markings on a dark thorax certainly have a striking resemblance to a skull and cross-bones, and this has given the insect its name (*Acherontia atropos*); but, like all similar resemblances, it is simply one of the accidents of Nature. It is a European moth, and Dan very accurately illustrates the feelings with which it was formerly, and, indeed, is now, regarded by many people. Latreille informs us that the sudden appearance of these insects in a cer-

FIG. 28.—DEATH'S HEAD MOTH AND LARVA.

tain district of France, while the people were suffering from an epidemic disease, was considered by many persons the cause of the visitation. There is a quaint superstition in England that the Death's-Head Moth has been very common in Whitehall ever since the 'martyrdom' of Charles I.

"The insect is widely distributed. I have seen fine specimens from Germany, Africa, and Asia, in the collections of Mr. Titian Peale and the American Ento-

mological Society. (Fig. 28.) It is a fine insect, perhaps the largest in Europe—the spread of wing sometimes reaching six inches. The larva is enormously large, sometimes five inches in length, and, like our Five-spotted Sphinx, feeds upon the potato-plant. The jessamine is also a favorite food-plant. But here is Sarah, with sweet cider and apples, and I see that Jenny is bringing us some cake. Suppose we give ourselves a short recess, in order to enjoy the refreshment."

CHAPTER VI.

TELLIONELLA AND POMONELLA—A CHRONICLE OF "OLD CLO'S" AND WINDFALLS.

"PERMIT me to add my contribution to the museum," said the Mistress, entering the room. She bore in her hands a rug, which she hung over the back of a chair close to the light. The little napless patches showing here and there like islands in an ocean, revealed the presence of that enemy of the housewife, the clothes-moth.

"Ah! here we have something interesting," I exclaimed. "There is no one of all the Lepidoptera whose habits better repay study than this little fellow."

"What a pity," interrupted the Mistress, "that so many very interesting people and things in this world have the misfortune to be such miserable transgressors! Now, here are these little wretches who play such havoc with our carpets, furs and cloths, so attractive in their characters that you natural philosophers all go off into enthusiasm over them. How do you account for such a seeming contradiction?"

"I allow that the little fellows are great rogues, and suppose it must be Nature's way to reconcile us to their mischief by bestowing upon them such cunning habits.

FIG. 29.—THE MISTRESS'S CONTRIBUTION

Besides, what right have we to complain? We slaughter birds and beasts for feathers and furs; we kill the silk-moth to get us a gown, and then think it hard if this poor worm makes a few raids for food and clothing upon our stolen finery! No, no! we must be just, at least. However, let us look at this rug closely, and I think we shall conclude that we have been well repaid for all our loss here.

"There are several species of moths similar in habits, whose caterpillars feed upon animal substances, such as furs, woolens, silk and leather. Moreover, they are dreadful depredators in the naturalist's cabinet, devouring his specimens remorselessly, so that you see I have had occasion to practice the toleration and charity which I preach. And why not? The creatures are only fulfilling the mission imposed upon them by the great Author of their being—to purify the world of its dead tissues.

"You might add to their virtues," suggested Abby, sarcastically, "the fact that they contribute largely to increase the stock of the 'old clo's' merchant, and thus confer indirectly a favor on the poor by cheapening clothing."

"Thank you!" I replied. "Any championship is welcome to a losing side, and many a true word has been spoken in jest."

"These moths belong to a family named Tinea by entomologists, such as the tapestry moth (*Tinea tapetzella*), the fur-moth (*Tinea pellionella*), cabinet-moth (*Tinea destructor*), and clothes-moth (*Tinea vestianella*).

The species which has been at work upon this rug is probably Pellionella, the only 'clothes-moth' known in the United States the larva of which constructs a case for its occupancy.

"The moths themselves are very small, expanding their wings not more than eight-tenths of an inch. They are thus well fitted for making their way through minute holes and chinks. If they cannot find such a tiny avenue into wardrobe or bureau, or fail of the opportunity of an open drawer or door, they will contrive to glide through the keyhole. Once in, it is no easy matter to dislodge them, for they are exceedingly agile vermin, and escape out of sight in a moment. The mother-insect deposits her eggs on or near such material as will be best adapted for the food of the young, taking care to distribute them so that there may be a plentiful supply and enough of room for each."

"Isn't that a bit of pure maliciousness?" queried the Mistress. "The mother, I suppose, scatters her eggs so that her ravenous caterpillars may do all the damage possible by attacking many parts of a garment at the same time."

"That is a bit of pure maternal instinct," I answered. "The mother-moth wisely arranges that all her offspring shall have a fair outset in life—enough to eat and wear. When one of this scattered family issues from the egg its first care is to provide itself with a domicile, or, if you please, a dress. It belongs to that class of caterpillars that feed under cover. I once placed one upon a desk covered with green cloth and

set myself to watch it. It wandered about for half a day before it began operations. At last, having pitched upon a proper site, it cut out a filament very near the cloth, in order, I suppose, to have it as long as possible, and placed it on a line with its body. It then immediately cut another, and placing it parallel with the first, bound both together with a few threads of its own silk. The same process was repeated with other hairs, till the little creature had made a fabric of some thickness, and this it went on to extend till it was large enough to cover its body. Its body, by-the-way, as is usual with caterpillars, is employed as a model and measure for regulating its operations."

"That's a very human trait," said the Mistress; "my mother invariably used part of her body as a yard-stick, measuring light material with outstretched arms, or with one full-length arm, counting from chin to fingers."

"Mother Bond does that still," ventured Harry.

"Ah, well," I said, "perhaps by-and-by we may find some starting-points for a bond of sympathy between the ladies and even a clothes-moth! But to proceed. My caterpillar made choice of longer hairs for the outside than for the inside, and the covering was at last finished within by a fine and closely woven tapestry of silk. I could only see the progress of its work by looking into the opening at either of the ends, for the covering was quite opaque and concealed the larva. In weaving this lining the creature turns around by doubling itself and bringing its head where the tail had

FIG. 30.—A CASE OF "OLD CLO'S" AND CHARITY.—*p.* 86.

been, the interior being left just wide enough for this purpose.

"Its dress being in this way complete, the body quite covered, the larva begins to feed on the material of the cloth, which you see is its 'bed and board' and wardrobe besides. Soon, like a growing boy, our young Pellionella outgrows its clothes. As it has no father's or big brother's worn suits to furnish material, and no

mother who has learned the art of Burns' Scotch Cotter who 'gars auld claes look amaist as weel's the new,' it proceeds to enlarge its own garments. It sets to work as dexterously as any tailor, slitting the coat or case on the two opposite sides, and then adroitly inserting between them two pieces of the requisite size. It manages all this so as not to expose its body, never slitting the whole length of the coat at once."

"Why," exclaimed Abby, "the worm has learned the mystery of a *gore!* Here is certainly a fair beginning for that bond of sympathy of which you spoke between the clothes-moth and the dressmaking part of womanhood!"

"Shall we congratulate the moth or the mantua-maker on the connection?" I asked.

"Really, I am not quite so sure with an answer as I would have been a few moments ago. My respect for the little wretches has vastly increased. I don't know how I shall muster courage to kill them hereafter!"

"By taking advantage of this pecular genius for patching," I continued, "or for *gores*, as Abby puts it, clothes-moths have been forced to make their tubular coats of divers colors and patterns. By shifting the caterpillar from one colored cloth to another the required tints are produced, and the pattern is gained by watching the creature at work, and transferring it at the proper time. For example, a half-grown caterpillar may be placed upon a piece of bright green cloth. After it has made its tube, it may be shifted to a black

cloth, and when it has cut the longitudinal slit and has filled it up, it can be transferred to a piece of scarlet cloth, so that the complementary colors of green and scarlet are brought into juxtaposition and 'thrown out' by the contrast with the black. In this way the little worm, by friendly human manipulation, may by-and-by find itself arrayed, like the favorite son of Jacob, in 'a coat of many colors.'

"The moth-worms pass the summer within these silk-lined rolls, some carrying them about as they move along, and others fastening them to the substance they are eating. Concealed within these movable cases, or lint-covered burrows, they ply their sharp reaping-hooks amid the harvest of napery throughout the summer. In the fall they cease eating, make fast their habitations, and lie torpid during winter. Early in spring they change to crysalids within their cases, and in about twenty days thereafter are transformed to winged moths, which fly about in the evening until they have paired and are ready to lay eggs.

"We are indebted to the Mistress for another contribution to our collection," I continued, picking up an apple from the dish. "This little brown hole in the side of our noble fruit suggests the story of a life. Do you know what made this opening, Joe?"

"Oh, yes, sir," was the ready response, "it is where an apple-worm got in, and you'll find it at the core."

"Partly right and partly wrong. The apple-worm did make the hole, but this is not where it entered the fruit, and we shall not be likely to find it inside, al-

though it is just possible that we may. However, let us cut the apple in half and see. Here, you observe, is a little burrow curving through the core between the eye (Fig. 31) and the hole in the skin, and branching off at the center, piercing the apple again at a point above. The worm that ate out this burrow is the caterpillar of the codling-moth, *Carpocapsa pomonella*. It is a small insect, its wings expanding three-fourths of an inch; they have the appearance of brown watered silk, and on the hinder margin of each of the forewings is a large oval brown spot, edged with copper-color. The hind-wings and abdomen have the lustre of satin."

FIG. 31.—BURROW OF APPLE-WORM.

"Why is it called the *codling*-moth?" asked the Mistress.

"Suppose we refer that to the Schoolma'am," I answered.

"Suppose we refer it to the dictionary," said Abby, taking down the book from the shelf. "Here it is":

"'*Codlin*, or *codling*'—spelled with one *d*, by-the-way—'An immature apple.' And here are uses of the word, one by Shakespeare: 'A codling when 'tis almost an apple;' and one by King, 'In cream and codlings reveling with delight.' I confess that is quite new to me. My notions of the word savored chiefly of

our New England staple, codfish—*codling*, a young cod. What a useful book a dictionary is!"

"Yes, when one has learned the art of using it. Had you looked further you would probably have found that *cod* is an old word for *pod*. An apple is simply an edible pod, the case that contains the seed of a tree. Now we may get back to our story.

"Pomonella is an immigrant, not a native American; she was imported to this country about the beginning of this century, and has so well improved her time and opportunities that her progeny may be found in nearly the whole of North America."

"Whence did she come?" asked Abby.

"From Europe, directly, at least, to us."

"There! I am glad to learn that," returned the Schoolma'am. "I shall make good use of the fact when I next hear of America's viciousness in sending the Colorado potato-beetle to England."

"Well," said the Mistress, "didn't we send the potato first? Surely, our cousins should share with us the entomological 'trimmings.'"

"All of which," I resumed, "would scarcely recompense our apple-growers for great loss inflicted upon their orchards. There are two broods of insects every year. The early brood appears about the time of apple-blossoms, having spent the winter in the larval state. In spring the larvæ change into brown crysalids; shortly after, the moths appear. The female moths seek the young fruit just as it is forming, and deposit their tiny yellow eggs in the calyx or eye, that is, the

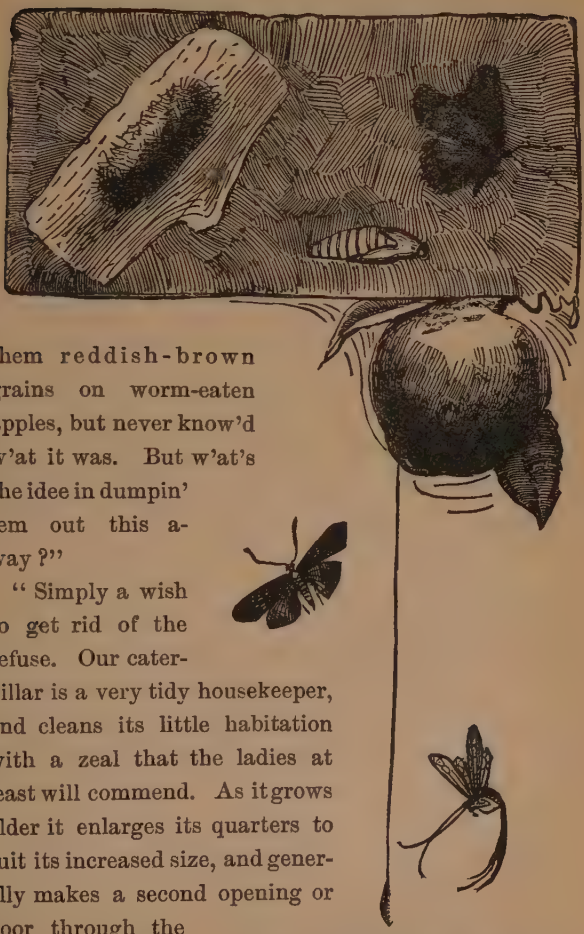
blossom end of the apple. Only one egg is laid on each apple, but as the mother has about fifty eggs to dispose of, you may suppose that a few wide-awake and healthy females can make sad havoc with a crop."

"Ain't the same apples visited by more'n one moth?" asked Hugh.

"Sometimes two worms will be found in one apple; but this is quite rare, and the fact commonly illustrates the force and wisdom of the maternal instinct that directs the moth.

"The eggs begin to hatch in about a week after they are laid, and the little caterpillars produced from them immediately burrow into the apples, making their way gradually from the eye toward the core. The caterpillar is of a whitish color; its head is heart-shaped and black; the top of the first ring or collar and of the last ring is also black, and there are eight little blackish dots or warts arranged in pairs on each of the other rings. As the larva grows the body becomes flesh-colored, the black parts turn brown, and the dots disappear. In the course of three weeks, or a little more, it comes to full size, and meanwhile has burrowed to the core and through the apple in various directions. The larva is so small at first that its presence can only be detected by the brownish powder that it pushes out in eating its way through the eye. This is made up of the 'castings' or exuviæ of the worm, and is a sure sign of infected fruit, as it often clings to the apple."

"True enough!" exclaimed Hugh. "I've often seed



them reddish-brown grains on worm-eaten apples, but never know'd w'at it was. But w'at's the idee in dumpin' 'em out this away?"

"Simply a wish to get rid of the refuse. Our caterpillar is a very tidy housekeeper, and cleans its little habitation with a zeal that the ladies at least will commend. As it grows older it enlarges its quarters to suit its increased size, and generally makes a second opening or door through the side of the apple, out of which frag-

FIG. 32.—COCOON, PUPA, FEMALE AND LARVA OF THE CODLING MOTH, AND A PARASITIC ICHNEUMON-FLY.

ments of food are cast. The effect of all these operations is to ripen the apple before its time, and hence we have what are known as 'wind-falls,' although the wind is not necessary to bring down the precocious fruit, for it tumbles in the stillest weather. These worm-eaten apples are gathered up by basketfuls, and are among the earliest brought to our markets."

"That is so," said Hugh; "and, now I think of it, we get such good prices for these early wind-falls that I doubt whether the apple-worm does as much harm as I'd thought. Many's the hard word I've said agin the little beggars, an' I reckon I'll take some of 'em back."

"What has become of the worm?" asked Abby, who had been carefully picking out the burrows in the cut apple. "There is certainly no trace of larva or crysalis here."

"True, and for a quite sufficient reason. When the apples drop, and sometimes while they are still hanging, our codlings escape through the opening in the side (Fig. 32) and creep into chinks in the bark of the trees, or into other sheltered places, which they hollow out with their teeth to suit their shape. Here each one spins for itself a cocoon or silken case as thin, delicate, and white as tissue paper. This is disguised or protected on the outside by attaching to silky threads small fragments of the bark of the tree or other available particles. (Fig. 32.)

"Three days after the completion of the cocoon the larva changes to a crysalis. The pupa is a pale yellow

color at first, which deepens in a day or two to pale brown. Two weeks thereafter the transformation is complete, and the imago or perfect moth escapes. This event occurs about the middle or latter part of July. Then follows the wedding-day, and in a few days more the female begins to deposit her eggs for the late brood of larvæ, the late apples being generally selected for this purpose. These larvæ mature during the autumn or early winter months. Sometimes they crawl out or swing themselves out before the apples are gathered, in which case they seek some sheltered nook under the loose bark of a tree, or other convenient hiding-place. But if carried with the fruit into the cellar, they of course spin their cocoons upon the boxes, bins, barrels, or walls."

"I have it now!" exclaimed Hugh, abruptly. "Beg your pardon, sir, but I'd been tryin' to think, w'ile you was tellin' about them cocoons, w'ere I'd seen sich objecks, 'n I jest happened to remember. Las' winter I found hundreds of 'em spun up betwixt the staves and hoops of the apple bar'ls. I noticed 'em as a cur'us thing, but didn't know w'at to make of 'em, and never tho't of 'em ag'in until now. Them was apple-worms; I'm sure of it now."

"I have no doubt of it, Hugh; and you provided them with snug winter-quarters, and then allowed them to escape, to come out last spring by companies to infest the apples. But you'll know better another time, I dare say."

"That I will, sir; and I'll pass the hint around

among my neighbors, too. There's a worm that bores into the pears, pretty much in the same way as the apples. Is that the same varmint ?"

"Yes; the apple-worm is very destructive to the pear, and is also found on the wild crab, and occasionally on the plum and peach. And now I believe that I have finished the story of Pomonella and how she punctures our apples."

"A very pretty tale it is, too," said Abby, looking up with a bright smile. "One of my classes was reading yesterday the legend of William Tell and the Apple, and I have just been wondering whether some of our myth-hunting critics and historians might not find the origin of that favorite story in the adventures of a codling-moth! I can fancy the mother Pomonella personating the tyrant Gessler, and imposing upon our Caterpillar—the William Tell of Insect-world, you know—the destiny of forever piercing apples!"

"But what will you have to represent the Switzer's little boy ?" I asked.

"Oh, the apple-bough, of course; and how nicely the idea of youth's immature age harmonizes with our definition of a 'codling'—the punctured, immature fruit!"

"At all events," said the Mistress, when the laugh at Abby's sally had ceased, "your mythical Tell maintains the legendary hero's reputation for archery. It rarely fails to 'bring down' the apple. But, really, I didn't know that our schoolmistress had such a genius for the so-called 'higher criticism!'"

FIG. 33.—A MOTHICAL VERSION OF TELL AND THE APPLE.

"Can you tell, please," asked Hugh, who had not quite grasped our by-play and evidently wanted something more practical, "how to get rid of the worms? I've tried smokin' them out, burnin' weeds under the trees, but that don't seem to amount to much."

"Of course, any smoking, to be effective, should be done in the season when the moths are laying their eggs. That may smother or drive away the mothers. I would recommend carefully scraping off the loose and rugged bark of the trees in the spring, in order to destroy the crysalids. Perhaps the most effective plan is the old-fashioned band-trap. A band of old cloth or a twist of common brown paper is wound around or hung in the crotches of the trees, or wrapped about the trunk. In these the apple-worms will conceal themselves, and thus great numbers of the larva and cocoons may be taken and destroyed from the time when they first begin to leave the apples, during the last of May, until the fruit is gathered. Of course, the bands should be often examined. There is one precaution, however, that is certainly very useful. As the larvæ leave the fruit soon after it drops from the trees, the wind-fallen apples should be gathered up daily and such immediate use made of them as will be sure to kill the insects before they have time to escape."

"Oh, dear!" cried Abby, laughing, "that means fresh—*cider!*" and she pointed to our empty glasses. "Shan't I help you to a little more? You must be thirsty from talking."

"Certainly; you shall not destroy my relish for the drink even though you make it sure that Hugh and Dan did put a few worm-eaten apples into the mill. I am reminded of a remark that I recently heard Dr. Joseph Leidy make at a meeting of the Philadelphia Academy of Natural Sciences. He had been making a

communication upon a certain large parasitic worm whose 'host' is our famous 'Delaware shad,' and concluded by saying that a portion of the fish—which I forbear to name out of respect for the epicures—that is considered the most delicious morsel of all, owes its delicate flavor to the presence of this parasite! 'I suppose,' said the distinguished naturalist, 'that our shad-loving friends would cease to relish this tidbit if they only knew the facts. But, then, why should they? —for the parasite is composed of *pure shad*, and nothing more.' So I say of——"

"Oh, you needn't explain," interrupted the Mistress, "the application is quite obvious. But for the benefit of the rest of the family, if not for your sake, I beg to say that Hugh has strict instructions to use only sound apples for cider."

"True enough, ma'am," said the farmer; "and you may be sure that we are all very careful. Miss Abby says that takin' care of win'-falls means cider. Not at all, ma'am; it means good feed for the pigs and for the cows, too, for that matter."

"I recant, I recant," cried Abby; "and so encouraged, I also will renew my glass."

CHAPTER VII.

MEASURE FOR MEASURE.

"I HOPE yo's gwine to hab mo' ob dem talks 'boo' de insecks, Mars Mayfiel'."

So Dan greeted me a few days after our first fireside meeting. He twirled his battered hat brim through his horny hands, then rubbed a white palm against the back of his grizzled locks, ducked his head forward and continued: "I doan jes kno' w'at yo 'd call 'em, sah, but Sary Ann 'lowed dey's *say-an'-says*. 'An' w'at are *say-an'-says*, Sary Ann?' says I. 'Wal,' says she, 'dey 's a sort ob free an' easy kine o' talk, w'ar yo says, an' den I says, an' all jine in an' helps de talk along. Now dat 's a powerful pleasant kine ob affar, Mars Mayfield, an' suits us 'ns heap better 'n loafin' roun' de kentry store, an' sich. So we uns—dat 's Hugh's folks an' Sary Ann an' me—we makes bold to ax yo, wouldn't yo 'low us de priv'lege ob jinin' in de *say-an'-says*, in case yo gwine to hab mo' ob 'em, an' we sincerely hope yo is."

"Why, Dan, I hadn't thought much about it," I answered. "But you may be sure if there should be any more 'say-an'-says,' you all will be welcome to the fireside."

"T'ank yo, sah; we 's all powe'ful 'bleeged to yuh,

FIG. 34.—THE GEOMETRID HORROR.—*p.* 104.

an' hopes we 'll hab de pleasure ob yo company at anoder conbersashull family fireside say-an'-say, bery soon."

Although I laughed at Dan's magniloquence, I was more gratified at that hearty honest approval of my humble dependents than I had often been before at commendations of cultured friends. To be sure, I learned by-and-by that the Mistress was also in the plot, and that Dan's praises were in good part an echo of her promptings; but the pleasure of the moment was not dimmed by that knowledge. Thus it came about that the next Saturday evening found our house-

hold gathered in the old sitting-room for another entomological 'séance.' Where Sarah had picked up that word, and how she had managed to transform it, we never learned, but we were all so impressed with the superiority of her version, that the cook's title was at once naturalized, and 'the Tenant's Say-an'says' became one of the current phrases of our little realm when we were in a merry mood.

"I have here a specimen," I began, "plucked from a straggling sprig of wood-wax or dyer's weed (*Genista tinctoria*) which represents a very familiar race of caterpillars, the Geometers, or span-worms. They are so called from the mode of walking peculiar to the larvæ. Most of these have only ten legs, six of which are jointed and tapering, under the fore part of the body, and four fleshy prop legs at the hinder extremity. There are no legs on the middle of the body, and consequently the caterpillars are unable to crawl in the usual manner. When one wishes to advance it grasps the object firmly with its fore feet, and then draws up the hind feet close to them, not unlike the attitude of a cat which meets a strange dog. The hinder feet then take a firm hold and the body is projected forward until the fore feet can repeat the process. This mode of progression is popularly called 'looping,' and the caterpillars are called 'loopers.'

"The Geometers live as larvæ on trees and bushes, and most of them undergo their transformations in the ground, to reach which by traveling along the branches and down the trunk by their peculiar gait would be a

long and tedious journey. But they are not reduced to this necessity, for they have the power of letting themselves down from any height by means of a silken thread which they spin from their mouths while falling. Whenever they are disturbed they make use of this

FIG. 35.—ORGYIA LEUCOSTIGMA, TUSSOCK MOTH. MALE, FEMALE AND LARVA, NATURAL SIZE.—*p.* 106.

faculty, drop down suddenly and hang suspended till the danger is past, after which they climb up again by the same thread."

"These, then," said the Mistress, "are the little

creatures that used to make a promenade along our streets in summer a horror to ladies before the advent of the sparrows ?"

"The very same ; but I doubt whether citizens have made a favorable exchange for the pretty hairy creeper, the caterpillar of the Tussock-moth (*Orgyia leucostigma*), (Fig. 35), that now fills the squares, fences and walls with its knobby white cocoons." (Fig. 36).

FIG. 36.
COCOON OF TUSSOCK MOTH, NATURAL SIZE.

"Why, don't the sparrows eat *them*, too ?" asked Abby.

"Ah, a mere question of taste. The soft, smooth, Geometers are a dainty bit to the birds, and the plumed crawlers are not at all to their liking. Why, I have seen the very bird-boxes in the public square covered with the Tussock-moth's cocoons—crowned with their white egg-masses. Were the caterpillars crawling at their very doors, and their hungry fledglings gaping for food, the parent birds would come home without supplies rather than forage upon the Orgyia worms. So the larvæ breed securely and in yearly increasing numbers.

"If a little wise energy and forethought could be shown by the city authorities in this matter, the evil could soon be remedied. The chief sites of these cocoons

are the iron fences around the squares, the trunks of trees, the walls and fence cornices of adjacent properties. If these were thoroughly cleansed, the cocoons scraped out and burned in winter, there would be a scant crop of span-worms in summer. For several years I have watched these troublesome cocoons advancing a little further each season up the trunks of the trees and multiplying along public places, and I have more than once predicted that the nuisance would ere long be well-nigh intolerable. But an American city, like Issachar among the tribes, is a 'strong ass crouching down between two burdens,' who sees 'that rest is good' and 'bows his shoulders to bear,' and hardly even exercises the healthy Anglo-Saxon right of grumbling at official ignorance and neglect. So canker-worms—not those alone which are comparatively harmless, but those of the moral, social and political sort—breed in public places, crawl unmolested through every highway and byway, and spin and nest in all departments of communal administration and life. Alas! Well, 'a stitch in time saves nine.'"

"And there are some citizens," cried the Mistress, apparently quite oblivious of my figurative speech and philosophy, and reverting to the encroachments of the Orgyia, "who allow those dreadful worms to crawl up their very walls and doorways and build cocoons under the mouldings and ledges of doors and windows quite unmolested. I see hundreds of them housed in such places the entire year. Such house-keeping! I can't understand how ladies will tolerate it."

"Perhaps," suggested Abby, "they tolerate the

worms out of the same mercifulness from which they feed the vixenish sparrows who refuse to kill the worms."

"A truce to our moralizing," I said; "let us return to our span-worm hanging from the tree. The manner in which it ascends its thread is most interesting. In order to do this it bends back its head and catches hold of the thread above its head with one of the legs of the third segment of the body. It then raises its head and seizes the thread with its jaws and forelegs, and by repeating the same operations with tolerable rapidity it soon reaches its former station on the tree.

There is another interesting habit which these Geometers possess; when not eating, many of them can rest on the two hindermost pairs of legs against the side of a branch, and stretching out the body nearly horizontally remain in that position for hours, so that they might easily be mistaken for the twig of a tree. If Joe and Harry would like to get some slight idea of the muscular force required to perform this action, let them grasp an upright pole with their hands and try to hold the body out horizontally. The feats of trained gymnasts in the circus ring or turnverein are fairly outdone by these despised span-worms. I think that you will agree with me that they are interesting little fellows. Moreover, notwithstanding the disgust with which, as the Mistress says, the city folk used to regard them as they dropped from the trees, I venture that there are plenty of people who would rather welcome their presence than otherwise. Perhaps some of our young people can tell us why?"

"I can, sir," Harry answered promptly. "Jenny used to say that it was a sign we were goin' to git a new coat when one of them caterpillars was seen steppin' off distance on our

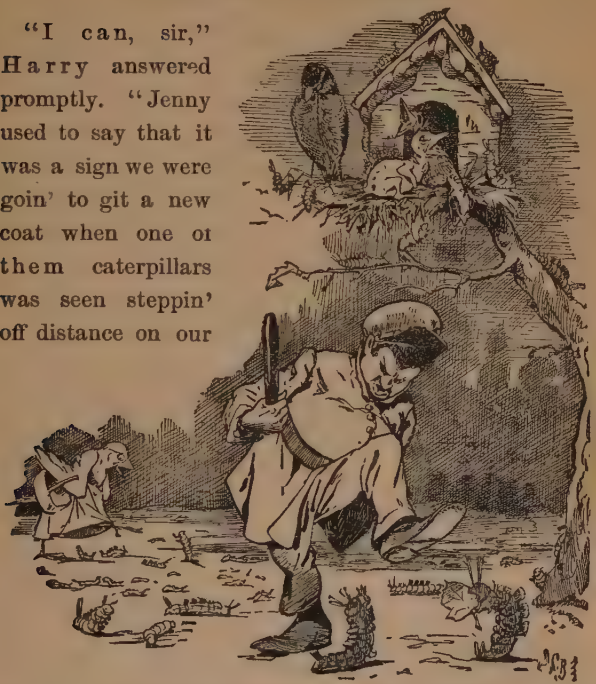


FIG. 37.—OUR IMPORTED PROTECTORS, MUTUAL DISGUST.—*p.* 106.

English Sparrow to Irish Guardian of American Peace—"Do your own nahsty work, sir; H'english sparrows, sir, didn't come 'ere to eat hup your nahsty H'american worms!"

arms or back. We call them 'measurin' worms' on that account."

"Yes, that is the idea: a new coat when seen measuring the arms or back, a new pair of gloves when seen looping on the hand, and so through the whole suit. I fear that, like many another local prophet, their promise is better than their fulfillment. However, we

cannot deny that in the proper season they are very diligent in suggesting the subject of new clothes to all passers-by who credit their prophetic office."

"A quality, by-the-way," said Abby, "which they share in common with the 'Barkers' in front of Market Street and Chatham Street clothing stores. And, like 'Barkers,' I imagine that their attentions are more respected by country folk than city people."

"Here is another of the Looper tribe, or rather a mother-moth, which fortunately I have been able to collect. I have two specimens, and they are mounted upon this bit of cork. Pass them around the circle and let all have a good look at them. They are not very familiar creatures in their moth or perfect form, but they are quite too well known in the larval state. Come, Miss Abby, you seem to be studying that specimen very closely, and meanwhile Hugh is anxious to see it, and will be much more so when he learns what it is. What is the matter now?" I asked, as the Schoolteacher shook her head and handed the insect to Hugh, with an incredulous 'Humph!' "My poor moth appears to have excited your indignation!" (Fig. 38.)

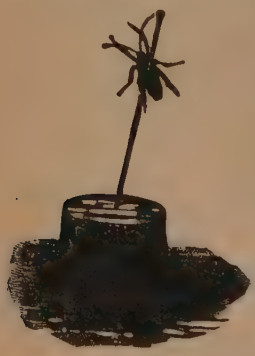


FIG. 38.— A MOTHER MOTH.

"Truly so," replied Abby. "I confess myself a tyro

FIG. 39.—A GEOMETRID TURNVEREIN.—*p.* 108.

in all branches of entomology, and it would be a sorry victory for a specialist who should impose on me. But really, I think that I have learned enough even within the last few days to prevent you palming *that* creature upon me as a *moth*. Why, it doesn't resemble that insect in the least."

"So say I," echoed the Mistress.

"And what says Hugh?" I asked, as the sturdy fellow turned the insect around slowly and carefully scrutinized it on all sides.

"Well, sir, I—I begin to find that I know so leetle 'bout the commonest sorts o' critters that I don't like to venture a 'pinion. But *of* that 's a moth, I reckon you 've pulled its wings off.

"Not a bad guess," I said, laughing. "But I assure you that it *is* a moth, and that I have *not* pulled its wings off. However, not to keep you in suspense, I may tell you that in certain species of moths the female is *wingless*. The pretty feathered caterpillar that we spoke of a little while ago as now infesting our public squares has a wingless mother. This is another example; it is a veritable moth, the female of a species known as the orchard moth (*Anisopteryx pomctaria*, Harris), a variety perhaps of the vernal moth (*Anisoptyrex vernata*, Peck). It is the mother of our northern canker-worm."

"The canker-worm? Indeed!" exclaimed Hugh. "Let me look at the creatur' again, please. Well, well! who would have tho't such pestiferous gangs uv varmin 'd a-sprung from a mite uv a beast like that!" (Fig. 40.)

"For my part," said the Mistress, "I think her quite ugly enough to be the mother of any kind of odious creature. Moreover, I shall owe her an additional grudge because our good professor here used her to victimize so mercilessly his confiding pupils. Think what our Schoolma'am—"

"Oh, dear, no!" interrupted Abby, smiling good-

naturedly. "I decidedly deserved it; and, besides, I practice similar modes of impressing facts upon *my* pupils, and as it serves admirably, I can't complain in this case. I am sure that I, at least, will not forget that some mother-moths are wingless."

FIG. 40.—ORCHARD MOTH, WINGLESS FEMALE, WINGED MALE, AND LARVA.

"Very good, then; since I am fully absolved, I may resume our story. I captured these specimens as they were making their way up one of our apple trees, having just left the ground in which they had matured. It was formerly supposed that the canker-worm moths came out of the ground only in the spring. It is now known that many of them rise in the autumn and early part of the winter. In mild and open winters I have seen them in every month from October to March. They begin to make their appearance after the first hard frosts in the Fall, usually toward the end of October and continue to come forth in numbers according to the mildness of the weather after the frosts have begun.

"However, their general time of rising is in the spring, beginning about the middle of March, and they continue to come forth for the space of about three

weeks. The sluggish females instinctively make their way to the nearest trees, and creep slowly up their trunks. Their husbands, having better facilities for traveling, inasmuch as they are winged, delay their advent a few days, when they also leave their earthen cells and join the females, fluttering about and accompanying them in their ascent.

"Soon after this the females lay their eggs upon the branches of the trees. They place them on their ends close together in rows, forming clusters of from sixty to one hundred eggs or more, which is the number usually laid by each female. The eggs are glued to each other and to the bark by a grayish varnish which is impervious to water; and the clusters are thus securely fastened in the forks of the small branches, or close to the young twigs and buds. The eggs are usually hatched between the first and the middle of May, or about the time that the red currant is in blossom and the young leaves of the apple-tree begin to start from the bud and grow. The little canker-worms, upon making their escape from the eggs, gather upon the tender leaves and begin to eat. If there comes a snap of cold, and during rainy weather, they creep for shelter into the bosom of the bud, or into the flowers when they appear. The leaves first attacked will be found pierced with small holes; these become larger and more irregular when the canker-worms increase in size, and at last nearly all the pulpy parts are consumed, leaving little more than the midrib and veins.

"The worms when well fed grow to be an inch long;

FIG. 41.—THE CLOTHES BARKER'S PARADISE.—*p.* 110.

they quit eating when about four weeks old, and begin to leave the trees; some creep down by the trunk, but great numbers let themselves down by threads from the branches, their instinct prompting them to get to the ground by the most direct and easiest course."

"Oh, yes," said Joe, "I have seen them hanging that way from the branches that jut across the road. It kept us dodging to get rid uv 'em as we drove along."

"Aye, and I doubt not you helped nature in distributing the little fellows along the road-side, for they lay hold upon passing objects and are carried goodly distances before shaken off. When they reach the ground they immediately burrow in the earth to the depth of

from two to six inches. and make little cavities or cells by turning around repeatedly and fastening the loose grains of earth about them with a few silken threads. Within twenty-four hours afterward, they are changed to crysalids in their cells, where, as we have seen, they transform in the autumn and winter as well as spring. They usually come out of the ground in the night, when the females may be seen straggling through the grass from various points of the area bounded by the spread of the branches, and making toward the trunk."

"You didn't tell us what becomes of the mother-moths," suggested Harry.

"There is little more to be said about them, for they are very short-lived; when they have laid their eggs they begin to languish, and soon die."

"You spoke of the worms takin' to the apple-trees," said Hugh, "but I find thet they aren't very pertikler in their tastes, so 's they kin git a holt 'v suthin' thet damages the farmer. I 've found 'em on the cherry and plum, and they 're special fond uv the elm."

"That is true; and you might extend their bill of fare to some other cultivated and native trees, as well as many shrubs."

"Is this the canker-worm of which we read in the Bible?" asked the Mistress. "It seems to have been a great scourge to the people of Palestine and those parts."

"It is not easy to answer that question. The exact meanings of words used in the Hebrew Testament to express all forms of animal life, are hard to determine. Some have supposed the word translated 'canker-

worm' to refer to the locust or at least to the larva of the locust; but the words rendered 'palmer-worm' and 'caterpillar' seem to have had reference to some species of canker-worm."

"I should like it amazingly if you could tell me how to get rid of the varmin," remarked Hugh.

"Practical entomology is not much in my line," I answered, "and I fear that such a theme would not greatly interest the majority of our little circle. But I can tell you of an ancient remedy that was supposed to be very effective. In the early part of the seventeenth century the peasants in many places in Germany took this mode: they pulled a stake from a hedge, looped around it a rope which they rapidly drew back and forth until the friction kindled it into a flame. This they carefully fed with stubble and dry wood. When the bonfire had quite burned out the peasants collected the ashes and spread them over their garden vegetables, confident that by this means they could drive away the canker-worm. This fire they called the 'Nodfeur,' or, as we might say, the 'Need-fire.'"

"You don't mean to say, sir," asked Hugh, "that you think the Nodfeur ashes really did any good in keeping off the canker-worms?"

"Why not?" I inquired.

"Tut, tut!" exclaimed the Mistress. "I am sure you don't indorse any such nonsense. It was pure superstition that prompted the custom, and you haven't much of that element in your mental make-up, I know well."

"The question," I rejoined, "was not whether the custom originated in or was maintained by superstition, but whether the Nodfeur ashes were beneficial; and I answer that confidently in the affirmative. If one were to sprinkle such material upon the vegetables when covered with the morning dew it would adhere to the leaves and thus make them distasteful to the caterpillars. This says nothing of the effect of the potash in the ashes, which may be injurious, nor of the dislike of larvæ and, indeed, of many insects to move over surfaces covered with pulverized matter. I attribute nothing at all, of course, to the effect of the *fetich*, but much to the protection given by making the natural food-plant obnoxious to the worms.

"There is another element which enters into the utility of this and all like remedies. Many years ago I read an incident which illustrates my thought. I repeat it from memory, and cannot vouch for all the details, but give the substance of the story as I remember it. A noble German lady found that despite her best endeavor there was a vast wastage in her household and a consequent trenching upon her limited income. At last she went to a hermit famous for godliness and wisdom, and asked for a charm to protect her from this grief. The good man gave her a little sealed box, containing the required charm, instructing her to place the same in one corner of every room in her house and out-buildings once every day, varying as much as possible the hour of her daily visit. He bade her, also, return at the end of a year to report results.

"A year passed and the lady returned with good news and a grateful offering. The charm had wrought wonders. Her household was never in such goodly condition, the wastage had stopped, the continual anxiety over insufficient income had ceased, her husband was delighted, her neighbors full of praise. She begged for a renewal of the charm, declaring that she would not be without it for much money.

"The monk broke the seal and showed the contents of the box. It was empty! 'See,' he said, 'there is no charm here! That which has wrought the good results over which you rejoice, has been your own care for every part of your house. As you went to each room you saw what was needed and supplied it, what was wrong and righted it. Your eyes were upon all your men and maids, as well as on their work every day, and they felt the influence of this oversight. There has been no other charm than this, and you need no other. Go, lady, and henceforth hold faithfully to the rule and habit of the past year, and be assured that your home will be a well-ordered, prosperous and happy one.'"

"Truly," said the Mistress, "that was a wise old monk. I can vouch for it that a constant personal inspection of all one's house, especially of the cuddies and corners, will work like a charm toward good housekeeping. But really, I don't quite take the application of your story to the German peasants and their canker-worms."

"Indeed! Then you are not apt as usual to see a point. In fighting insect pests it is precisely as in

housekeeping. The constant oversight of every plant discovers the destroyer and leads to its prompt destruction. The man who daily visits his growing vegetables, with or without ashes or other preventive, will see the canker-worms and kill them. Nor does once going over the crop serve. The worms are legion; each day has its own host, which must be met *that* day before devastation begins. I have the notion that the old-time Nodfeur custom may have looked also to this point. Perhaps some wise observer, who knew that men will often maintain good habits better under the spur of a superstition than the stimulus of simple good sense and experience, may have set his neighbors to defend their crops by the invention of a bit of supposed harmless superstition. Or, more likely, the superstition gradually grew around what was originally only a wise rule of successful horticulture."

"Well, sir," remarked Hugh, "You 're quite right in thinkin' that constant watchin' is the great thing in raisin' garden sass. I 've had the best kind o' luck in the very worst years for worms and bugs, jist by goin' over and over the wines. I knock off the critters into a pan an' then kill 'em. It 's a good deal o' trouble, but ef a man wants wegetables he 's got to do it, I reckon. There 's allus a few days w'en the varmin is particlar bad, an' by standin' to 't mornin' and evenin' durin' those days a feller 'll come out purty well."

CHAPTER VIII.

INSECT TROGLODYTES.

ONE of our favorite walks, during these autumn days, leads across the meadow, down the hill-slope, over the brooklet, and so, by a rocky steep beyond, through a thick woods to the banks of Crum creek. On the occasion of which I am now to write my companion was an elderly clerical friend, the Rev. Dr. Goodman. The Doctor is a noble example of the old-time clergyman. His tall, sturdy frame, scarcely bowed by his seventy years, is always robed in becoming black, never, in any contingency, omitting the indispensable dress-coat. His full curly white hairs fall upon his neck beneath a broad-brimmed black hat, a compromise between the Quaker pattern and a Yankee wide-awake. His strong, benignant face is clean-shaved, and his well-turned chin, just verging upon the "double," is lifted above a broad, white choker, between the wide-apart points of an old-fashioned standing collar. In these latter days his waistcoat has expanded somewhat above a growing rotundity, and beneath it a goodly fobchain protrudes. The gold watch to which it dangles, and the portly gold-headed cane which he carries, are both the gifts of his warmly-attached parishioners. His salary is modest enough, though somewhat more generous than Goldsmith's parson, "passing rich with forty pounds a

year ;" but as his church owns a cozy manse and ample glebe, he lives contentedly and even comfortably, with his wife and two daughters. His home is at Marple, six miles across the hills, and he has driven over to spend a night at the Old Farm and renew a pleasant friendship formed during seasons when one summer had been spent within his parish.

As his rumbling old carryall turned down our avenue behind the fat, chestnut-bay horse whose lazy jog-trot is known through all the country side, the familiar sight stirred up very pleasant thoughts.

"My dear Doctor," I exclaimed, greeting him at the gate, "you are welcome, indeed! To what fair fortune are we indebted for this pleasant surprise?"

The good minister was altogether too guileless to ward off this direct query without uncovering the truth. He blushed, hesitated and glanced appealingly at the Mistress, who had now joined in the greeting.

"Ah! I see how it is," I said, coming to the relief of the embarrassed parties; "another conspiracy in my behoof!"

"Just so, just so!" exlaimed the Doctor, nodding his head with unction, while his face beamed a happy smile. "And I 'm heartily glad the cat 's out of the bag, although I suspect *this* particular cat is a very harmless kitten! However, it 's all right now, and I 've come to spend the evening with you."

So I knew that the hand of the little Mistress, the true guardian angel of those invalid days, had touched the spring that moved the Doctor hitherward; as,

FIG. 42.—ANCIENT CAVE-DWELLERS.—*p.* 124.

indeed, it had similarily done on so many kindred occasions.

The Doctor, like most of his profession, has always had an intelligent interest in natural science, and, moreover, cultivated a speciality in ethnology and archeology. He is deep in the problem of man's antiquity; and what with works on "Preadamites," "Cave-Hunting," "The Epoch of the Mammoth," "The Story of Earth and Man," "The Races of Man," etc., has a busy time in keeping his friends of the modern school in harmony with his older friends of the Usherian Bible chronology. He brought over with him, on his present visit, a recent work on "Early Man in Europe," which we had abundantly (not to say thoroughly) discussed during the evening after the lamps had been lit and a fire kindled on the hearth. "Just for the wee bit blinkin' o' the ingle," wife said, "and to mellow the night chill of the advancing fall." The frontispiece of the Doctor's book is some ideal scene of troglodytic life. It is a night scene: a fire is burning in front of a rocky cavern, around which the dusky forms of a primitive family are grouped; a full moon shines in the background, and in the foreground a pack of hungry wolves are pushing up over the rocks as near as they dare come to the fire, which thus, in more than one sense, protects the unconscious cave-men (Fig. 42.) The picture, at least, succeeded in stirring up the imaginations of our Mistress and the inquisitive Schoolma'am, so that the Doctor had full room to expand upon his favorite theme.

"Well, Doctor," I said, when we had finished morning worship, "I have something to show you down here that will gratify your antiquarian interest in your fellow-men. Moreover, I think I can put you on the trail of a race of troglodytes of even more ancient descent than those of whom you told us last night."

"Indeed! But—tut! you are trying to quiz me, I see."

"Not in the least; get your hat and cane, and let us walk over to the creek; you shall judge if I am not in good earnest."

"Well, well, I confess that I am incredulous still; but it 's a fine morning for a walk, at any rate, and there 's nothing gives such interest to a journey as some pleasant motive and destination."

"There 's a deal of deep philosophy in that remark," continued the good man after a pause, during which he had arrayed himself for the excursion, "a philosophy that one does well to apply to all the pilgrimage of this life and its final destination, which I hope may be a happy one for us all. Ah! excuse me, I really did not mean to preach!" And he did not, for the blush mantled his face, and he looked askance at me as though anticipating my displeasure. We were now fairly afield, and our thoughts turned again upon the troglodytes.

"There is one thing," I said, "that puzzles me in your view of the early cave-men. May I ask how you reconcile it with your belief as to the condition of the original pair of Eden?"

"To be sure! There 's no contradiction at all. Adam and Eve were very primitive, indeed, in their habits. Their moral nature was unclouded—therein lay their original perfectness. They were civilized men in that respect; in other particulars they simply had the rudiments of civilization. With natural intelligence such as man now possesses, with knowledge of fire, and situated in a soft and congenial climate, they rapidly developed, as we see in the family of Cain, the arts of herding, music, and smelting metals."

"Well, but were they troglodytes? Did they have those horrible struggles with the wild beasts of the earth hinted at in your book?"

"Certainly not; their environment saved them from such necessities. But then some of their posterity, as they scattered over the earth, relapsed from many of the acquired arts of civilized men, as they became vicious in morals, and falling upon adverse surroundings, it is not strange that they should have been troglodytes or cave-men of the rudest type—quite as savage as tribes of which we know to-day. But—pray, what is this? A grave, here in the meadow?"

We had been quietly jogging along the path, and now stopped beside a marble slab fixed in the midst of the field, that might easily have been taken for a grave-stone. It was eighteen inches in height, six in thickness and seven in width. It sloped with the descent of the hill, and around its base clumps of grass, clover and sheep-sorrel had gathered.

The Doctor lost no time in donning his spectacles,

FIG. 43.—CAVE-DWELLERS—ANCIENT AND MODERN.

and kneeling down beside the stone read the inscription:

JANE
TOWNES,
CAVE &
DWELLING
1685.

"This is your antiquarian rarity, is it?" he asked, rising. "It is certainly worth seeing; and now let us have its story, although I could guess the nature of it. I believe the name is that of one of our good old Quaker families, and the date carries us so near to the era of the settlement of our State that I readily conjecture the fact here commemorated."

"Yes, I see that you have easily guessed the truth, although it is often puzzling enough to those less familiar with our pioneer history. This farm was first brought under culture by Jane Townes, one of the early Quaker emigrants, who, with her three sons, came over to Friend William Penn's colony soon after the great founder's landing. The husband and father died on shipboard during the voyage to America; but the widow, with genuine pluck and faith, took up the burden of colonial settlement, and bought a plantation which included in its bounds our old farm. On this spot they made their first dwelling; they dug into the slope of the hill just here, threw out rough supports much like the props in a coal drift, and banked up the whole, thus making what was known as a 'cave.' Here the widow with her sons lived until timber could be cut from the thick woods that covered the site, and hewn and builded into a log house. One of her descendants had this cave-stone erected to mark the site of what was the first home of a white family in this neighborhood. The present stone farm-house has not yet seen its first century, having been built A. D. 1792."

"Well, that was a courageous woman certainly!" ex-

claimed the doctor, "and her pluck deserves a much better monument. However, I have no doubt she and her boys enjoyed their rude life quite as much as their descendants do these days of civilized abundance. There is a streak of the nomad in most men. Where was ever the boy who didn't long for a Robinson Crusoe's cave? There was always a fascination for me, when a lad in Ohio, in certain caves among the rocky masses of the Little Beaver. In those days the chief charm of a fishing jaunt was the fire and the noon lunch in caverns or under jutting rocks. I am sure that I should have greatly enjoyed those old pioneer days, so I will waste no pity on the hardships of good Jane Townes. But I must claim the other part of your promise. Where are the traces of those cave-men more ancient than the men of the Dordogne? I am eager to inspect them."

"Not so fast, Doctor. I did, indeed, promise you a sight of most ancient cave dwellers, but I said not a word of cave-*men*. My troglodytes are of the insect world, and, see there! Your foot has well nigh trodden upon the entrance to one of them."

The Doctor started back suddenly and looked downward. I stooped at his side and pointed out a little structure of straw that marked the cave of a turret spider, *Tarentula arenicola*. (Fig. 44.)

"Come, my good friend," I continued. "don your spectacles once more and join me in this search. Here is one of my ancient cave-dwellers, and I warrant that its ancestors were here to gaze in dumb wonder at the in-

truding cave dwelling and log cabin of the Quaker pioneers."

"Ah, you rogue!" said the Doctor, as he adjusted his glasses, "you quite deceived me, I confess; but I pardon you in advance, for I dare say that you will abundantly reward my curiosity, although in another direction."

The object to which our attention was directed resembled in miniature a chimney of mud and sticks, such as one may see upon log huts on the frontier. A circular opening in the ground an inch wide was sunk downward quite out of sight. Around this on the surface was built, in the form of an irregular pentagon, a little chimney or turret, composed chiefly of bits of grass-straw and stalks of weeds, crossed at the corners and raised one above another to the height of nearly two inches. The inside of this tube was lined with a thin sheeting of silken web which was carried for a little distance below the surface. Particles of earth were intermingled with the sticks.

"Do you mean to say," exclaimed the Doctor, "that this is the nest of a spider?"

"You shall see for yourself," I answered, "for I have brought with me the means for exploring the interior of our cave-dweller's home. But first we may as well save this part of the nest as a specimen for our cabinet."

I filled the turret with a tuft of cotton to prevent it from breaking up under the handling, then carefully cut it away from the surface with a large knife and laid it in a paper box. Next I quite filled up the hole, which

FIG. 44.—TURRET SPIDER'S NEST AND TOWER.

extended ten inches straight downward, with cotton, which was gently pushed down with a stick.

"Pray why do you do that?" asked the Doctor.

"I have three purposes: one is to prevent the broken soil from falling in upon the spider who is down there at the bottom of the cave; another is to mark the

track of the tube as the earth is cut away; a third to prevent the spider's escape.

"By the way, I was once led upon an interesting observation by this mode of filling up the burrows. Having a desire to keep a turret spider under close study, I cut out a burrow and took it home, preserved entire in the midst of the sod in which it had been dug. The spider was shut in by the cotton forced into the opening, and was kept in by a cotton plug in the lower part of the tube. Having snugly domiciled the exile by inserting her nest into fresh soil and sod packed in a half-keg, I removed the cotton from the upper part of the burrow, and left the occupant to work according to her own fancy. I was compelled to be absent for three days, and when I left home the spider was engaged in pulling out the cotton plug which had been placed in the bottom of the tube. Several pellets were already scattered around the turret. On my return I found the tower strangely transformed; the whole interior was lined with the cotton, which extended an inch or more below the surface and lipped over the top-wall. This novel lining was laid on as smoothly as though done by the delicate hand of an upholsterer."

"Very strange, indeed!" the Doctor exclaimed. "A most admirable instinct! Although, perhaps, it is hardly after the manner of what I have thought an instinctive act to be. Certainly there could have been no hereditary tendency to such a use of the cotton fibre. What think you?"

"Undoubtedly our spider had come upon new expe-

FIG. 45.—COTTON-LINED NEST OF TURRET-SPIDER.

rience and readily adapted herself to it. It is impossible to think that she ever before had knowledge of cotton and its uses for wadding. Her first purpose was evidently to remove the material from her burrow; but by the contact of her highly sensitive feet and mouth organs with the soft fabric the suggestion was raised that it might be utilized for lining her nest instead of silk. Or perhaps we may say that the sensation produced by handling the soft cotton started a train of associations that led the animal to deal with a substance quite foreign to her precisely as she habitually deals with the silk which she secretes. Whether the two theories do not amount to the same in the end is a point which I

will not attempt to decide. We are verging upon the deep and somewhat strange waters of animal metaphysics, and perhaps had better not venture further."

"At all events," said the Doctor, with some warmth, as though he were beating down an old adversary in his own thought, "I will never again say that a spider doesn't *think!* Here certainly is an order of mentalism which seems to differ from human thinking more in degree than in kind."

In the meantime I plied the spade carefully, until at last the bottom of the tube was reached.

"There she is!" cried the Doctor, who keenly watched the digging.

A brown head emerged from a mass of dust-covered cotton, followed by the legs and body of a large spider. The body was an inch in length, but the eight long, expanded legs gave one the impression of greater size. The specimen was a female of a velvety brown color, marked with light gray along the back.

"Yes, there she is," I responded; "this is one of my troglodytes; and now you have seen for yourself that this pretty nest in my box was really made by a spider."

"It is certainly true, although it passes all my notions of spider-craft. What is the use of this cave-nest?"

"I cannot answer very confidently. The deep burrow is at least a winter home, and, no doubt, a good one, since the temperature within it is much higher than at the surface. Moreover, it affords protection against many enemies, from whom the animal finds

ready refuge by running into its stronghold. The object of the chimney is less apparent. It probably serves as a watch-tower from which the keeper may observe the approach of her enemies and her prey. Her favorite position is a crouching posture on the summit of her turret, with legs drawn up and head peering over the edge as though on guard. A little elevation of this sort is a great temptation to grasshoppers and other insects, who are prone to alight upon or crawl up it, and thus become easy victims to the vigilant tower-keeper. On the other hand, if anything approaches that threatens harm, the wary sentinel retreats to the depths of her cavern. I suppose that the turret serves a further use in protecting the interior from being flooded by the water that gathers upon the surface after rain."

"Have you any knowledge of the mode of building practiced by this little architect?"

"Yes, I have kept individuals in confinement and watched their habits, but the best account of their behavior has been given by my friend, Mrs. Mary Treat. When the burrow is about two inches deep the spider begins upon her tower. A stick is placed at the edge of the tube, and lashed down with a strong thread. Another is laid in similar position until the margin is surrounded by a four or five-sided foundation. The builder then descends to the bottom of her tube and brings up pellets of earth which she places atop, and on the inside of the sticks, pressing them down with her body as she passes around the circle. Then follow

other layers of sticks alternated with pellets of clay until the tower is raised sometimes as high as two and a half inches above the ground. The inner surface is smoothed and lined with silk, and the turret is complete. While excavating the burrow the bits of clay as they are bitten loose are compressed within the mandibles into small balls, carried to the top and shot off from the walls with sufficient force to carry them a foot distant."

Our spider had now crawled out from beneath the dusty ruins of her home, and sat motionless upon a heap of dirt. The Doctor's eye caught sight of a spherical egg-sac as large as a grape which was lashed to the spinning-tubes at the end of the abdomen, and an explanation was asked.

"This species, like most of her family, carries her cradle, as you see. She rarely, if ever, abandons it, and will give up her life in its defence with the utmost abandon. For at least two months she has dragged that silken ball around with her, while the tiny eggs first placed within it have grown until they are now just ready to burst forth as baby spiderlings. If we capture this mother, and place her in a jar, we shall, in a few days, see a transformation. The egg-sac will have opened, a brood of a hundred or more younglings will have issued forth, and have swarmed upon their mother, hanging in a close cluster upon her abdomen, which will be quite hidden by the wriggling mass of wee bodies and legs. The mother will, of course, seem greatly enlarged by this addition, and will present the appearance of a horrible, hairy, nondescript monster.

FIG. 46.—A MOTHER SPIDER AND HER BROOD.

She may be seen thus hanging in her favorite posture upon the outer wall of her tower, her abdomen all a-quiver with the crowded life of her brood." (Fig. 46.)

"Dear me!" said the Doctor, laughing, "what a destiny that must be! Surely, that is a progeny sufficient to satisfy the cravings of the most capacious mother-love. One might fancy that the Mother Goose rhymster had this spider matron in view in the famous nursery couplet:

"'There was an Old Woman who lived in a shoe,
And she had so many children she didn't know what to do.'"

"The turret spider," I continued, "seems to know what to do with *her* children. During the first three weeks the little things are piled all over the head and back of the mother, often appearing to blind her. They

FIG. 47.—"SHE HAD SO MANY CHILDREN SHE DIDN'T KNOW WHAT TO DO."—*p.* 137.

seem ambitious to reach the highest point, and jostle and crowd one another in their efforts to be at the top of the heap. This the mother patiently endures for a time, but when the younglings thicken too closely over her eyes she reaches up her forelegs, scrapes off an armful and holds them straight in front of her as if disciplining them by reproving looks. Soon she releases them by slowly opening her legs, whereupon the spiderlings quietly take their places around the edge of the tower, where they usually remain until the mother goes below, when they all follow. Upon her reappearance they are again mounted upon her back."

"How do the little fellows keep their position so firmly?" asked the Doctor.

"The body of the mother is covered with soft hairs to which her babies hold by their feet, or fasten themselves by delicate threads spun from their spinnarets. When they are two weeks old they "molt" or cast their skin, a process which spiders undergo several times until they are quite mature. The molting of the young turret spiders is a curious sight. They stretch a line across the back of the mother's abdomen to which they fasten themselves. Then they begin to undress. The skin cracks all around the chest—the cepholotorax—which is held by the front edge alone; next the abdomen is freed, and then comes the struggle to free the legs. By dint of regular pullings, repeated at short intervals, the old skin is cast in fifteen minutes or more, and the spiderling appears undressed but quite exhausted. It lies limp, pallid and motionless for a little

while and then gradually resumes its activity. Sometimes the mother's back will be covered with taut lines decorated with these cast-off molts, reminding one of the dainty pieces of a baby's toilet hung up to dry in the laundry."

"How long does the mother keep her brood around her?" asked the Doctor.

"When the young are about three weeks old a few begin to leave the maternal care. They have been long enough 'tied to mother's apron string,' to quote a common saying that has quite as much fact as figure in it for our spiderlings. They climb up a grass stalk, then venture upon a higher weed or shrub, thence they reach the trunk of a tree, and, grown bolder now, climb out upon the branches. After another week the mother shows a disposition to send her brood adrift. The time for 'weaning' has come, and occasionally a little one is reminded of this fact by being tossed away into the grass. A bright, warm autumn day follows, and then the entire brood, moved by the resistless instinct of migration, leave their mother without further ceremony, run here and there upon plants and trees, or are distributed over the vicinity by aëronautic flight, that strange habit so strongly analogous to ballooning as practiced by men. Later in the season or in the spring one will find a number of tiny burrows, the very counterpart of the mother's, in which the young have set up housekeeping, or cave-keeping rather, for themselves. As they grow in size the burrows are enlarged, until at last the babes have themselves become mothers and re-

FIG. 48. — SEASIDE RESIDENCE OF TURRET SPIDER.

peat among their own broods the maternal instincts that fostered their baby days."

"There is an interesting variation in Arenicola's mode of building her turret which I have often observed along the New Jersey seaboard. Around the edge of the burrow, which is always driven straight downward by the spider, is heaped a foundation of tiny pebbles. These are usually white quartz, gathered from the surrounding sand. Upon this foundation the

tower is erected, and the varied material gives a pretty effect.

"If one carefully dig the sand away from the burrow, having first taken the precaution to drop a twig within it (see Fig. 48), he may expose the interior. The sandy walls of the excavation appear to be kept in place by a slight secretion of silk which melts into the interstices of the sand, and has sufficient consistency to maintain it intact. Supported thus upon the twig the wall looks something like the leg of a wee lace stocking dusted over with sand. I have succeeded in exposing unbroken fully two inches of this interior coating; but it required the most dainty manipulation."

"Truly," observed the Doctor, patting the ground with his cane meditatively the meanwhile, "the 'seeing eye' is a rare gift. Now, I have wandered and loitered over those seashore sands many scores of times and never saw such an object as that. I think that my next vacation jaunt will bring me a fresh enjoyment in looking up these troglodytic friends of yours."

CHAPTER IX.

CAVE-DWELLING INSECTS.

"HELLO, Harry! The Doctor wants to see a bumble-bees' nest. Can you find one for him?"

Harry, who was crossing the field within easy call, ran eagerly toward us at this greeting, for the very name bumble-bee has a stirring influence upon a lad who knows anything of the country. If there were a "bum-bees'" nest anywhere in the neighborhood I knew that Harry might be trusted to point out the locality; and accordingly the lad was soon at our side, his face aglow with a sense of importance and anticipated pleasure.

The Doctor, however, was taken somewhat by surprise. "My dear sir," he cried, "I am not the least aware of any such want as you have expressed. On the contrary, I heartily excuse Harry from all service in the way of humble-bee hunting."

"No, no, Doctor. You cannot escape so easily. You are committed to a search after the most ancient cave-dwellers, and it would be too bad to omit such distinguished representatives as the humble-bee. Here is Harry quite ready to encourage your antiquarian tastes, and he would be disappointed now were you to turn back. Can you lead us to a bumble-bees' nest, Harry?"

"Yes, sir," answered the boy with alacrity. "There's one just beyond here in a big tussock on the edge of the swamp-grass. Joe and I found it las' July, when they was a-mowin'."

"And resisted the temptation to clean it out? That was a marvelous example of self-denial for a growing boy. How did it happen?"

"We did mean to fight it, and was jest gettin' ready when father 'lowed ef we 'd wait till frost come we 'd have the nest without gettin' stung. But that wasn't the reason zactly," added the lad. "*I* don't mind bee-stings much, though some folks 's mighty feard uv 'em. Here 's the nest, sir."

Harry had well described the site, which is indeed a favorite one for these insects, who love to burrow in moist, low meadow land, near a great tuft of grass or tussock. Yet they give themselves a good deal of latitude in the choice of their subterranean homes, and often affect a grassy bank or lawn.

Harry pushed aside the grass and showed us the entrance or gate to the cave—a round hole half an inch in diameter. The droning *buzz-z-zz!* of a bee's wings warned us that one of the workers approached her nest. She circled around us cautiously and somewhat excitedly. There was a growing sharpness in the note of her hum which warned the Doctor to start back and pull the limp brim of his hat about his ears. Harry laughed, and sat still, simply withdrawing his hand from the opening. The bee gradually narrowed the circles of her flight, and after a few turns above the

FIG. 49.—ENTRANCE TO THE HUMBLE-BEE'S CAVE.

gate, as is her habit when home-coming, settled upon the ground and crept down the tube with a final buzz of satisfaction. She had thus unwittingly identified the site for us and confirmed Harry's report. (Fig. 49.)

"Now, Doctor," I remarked, "here is an oppor-

tunity to prove your devotion to science. Our little cave-dwellers are wont to defend their household treasures with some acrimony."

"My dear fellow," said the clergyman, "I pray you have me excused! I am too old and clumsy to engage in a battle with bumble-bees. If you stir up those mettlesome little beasts I shall certainly run away. Good morning!"

"Hold, hold, Doctor! I promise to spare you. But how shall we learn the mysteries of this cavern-home unless we take some risks in the work of exploration? Really, I am anxious, on my own behalf, to see the interior of a bee's nest; for I haven't seen one since my boyhood, and in those days there was rather too much excitement in the assault and defense to permit a careful study of the architecture."

Here Harry spoke. "I know where they're two other nests inside the yard, back of the house. Pap was telling Joe and me t' other day that we 'd hav' tuh clean 'em out anyhow, sence the folks 'ad come. So ef you 'd like to see a nest we 'll open one now for you, jest as leav 's not."

"Ah, that will do finely," I said; "so you see, Doctor, we shall get the spoils of victory without the perils of war."

"True enough," was the reply. "But isn't that very much like the patriotism of the great showman, Artemas Ward, who exhibited such self-sacrificing willingness to have all his wife's relations go to war?"

"Perhaps it is," I answered, smiling, "but we may

trust our boys to come out of the conflict without any serious hurt. They are experienced hands at bee-nesting, I warrant. And now, if you 'll consent to spend the day with us, we 'll defer our cave-hunting until evening. What say you ?"

The Doctor, who was quite prepared to humor my fancies and encourage me in these agreeable field pursuits, readily consented. Therefore, dismissing Harry, we turned our steps homeward.

As we walked over the moist, soft ground that skirts the edge of the Run, my friend noticed a ridge of loose, fresh earth heaved up along the low bank. "I see that a mole has been at work here," he remarked.

"Let us look a little more closely," I said. "The burrow which this ridge covers is certainly much like a mole's, but smaller than that animal makes. I suspect that we are on the trail of another of our insect cave dwellers—the mole-cricket. Yes, it is so, and here beneath this stone the burrow terminates." I turned over the stone, and exposed a simple opening into the earth.

"Where is the cricket ? " asked the Doctor.

"That is more easily asked than answered; somewhere near the bottom of his cave at this hour of the day, too far down for us to reach. But if you will visit his burrow with me this evening, I may satisfy your curiosity. The mole-cricket is a nocturnal insect, and will not be caught near the door of his den until dusk. If one will then push a long grass stalk into the opening the irritated inhabitant will probably grasp it,

and grass and cricket may be drawn out together. Our American species is known as the Northern mole-cricket (*Gryllotalpa borealis*), although, in fact, it inhabits nearly the whole of the great plains, from Louisiana to Massachusetts. Sometimes the bulk of the soil beneath the sod and stones for a rod from the water's edge will be found completely honeycombed with their burrows. They seldom penetrate to a depth of more than six or eight inches, rarely to a foot beneath the surface. The burrows are about one-third of an inch in diameter, entirely irregular in direction, and often terminate abruptly. When the ground is hard, the burrows are brought so near the surface as to raise long ridges of mould, which, when dry, frequently fall in and expose the interior."

"Does the mole-cricket chirrup like the traditional hearth cricket?"

"It does chirrup, or rather creak, but its note is different, resembling the distant sound of frogs, but somewhat feebler. It is most frequently heard about dusk."

"Why is the insect called a mole-cricket?"

"From the very fact, in part, that caused you to mistake his burrow for a mole's. The general shape of the insect contributes to this likeness, as well as the strange development of the fore limbs, and the peculiar formation of the first pair of feet, which are not unlike the corresponding members of the mole. There are other points of resemblance which are most extraordinary. Like the mole, the mole-cricket passes nearly the whole of its life underground, digging out long pas-

FIG. 50.—GRYLLOTALPA BOREALIS—THE MOLE CRICKET—ITS CAVE AND EGGS.

sages by means of its spade-like limbs, and traversing them in search of prey. Like the mole, it is fierce and quarrelsome, is ready to fight with its own kind, and, if victorious, always tears its vanquished opponent to pieces. Like the mole, it is exceedingly voracious, and if confined without food with several of its own species, the strongest will devour the weakest. We may close the analogy by saying that, like the mole, it is useful enough in the fields, where its tunnels form a kind of subsoil drainage, but is equally destructive in the garden among young plants and flowers, upon whose roots it feeds. The European species (*Gryllotalpa vulgaris*) is often quite a pest, but our American species has not yet

developed such destructive habits, perhaps from lack of opportunity."

"Well, well," cried the Doctor, "I quite join you in declaring this a most extraordinary creature. These are wonderful resemblances to exist in animals so widely separated as a cricket and a mole—an insect and a vertebrate."

"Perhaps," I suggested, thinking to draw the Doctor's theological fire, "the insect is a far-away ancestor of the vertebrate? At least, an evolutionist might have no difficulty in accounting for such resemblances by some application of his theory."

The Doctor glanced slily at me, smiled, and answered: "Ah! you shall not disturb my equanimity so. Evolution is no theological *bête noir* to me. Not that I believe it, at all; on the contrary, I think it is yet an unproved hypothesis. But, considered as a *method of creation* simply, I am willing to leave it wholly in the hands of the naturalists and philosophers. Of course, that materialistic view of evolution, which dispenses with a Divine Creator as the First Cause of all things, has no place in my thought. That is not for a moment to be tolerated; but, as for the rest, why should Christian people disturb themselves? Science has not yet said her last word, by any means, and we can well afford to wait. The only absolute condition that I name is, that evolutionists shall still heartily join us in the opening sentence of the Creed: 'I believe in God, the Father Almighty, MAKER *of Heaven and Earth*.' But, Mr. Mayfield, we are not driven of necessity to

evolutionism to account for such striking analogies in the animal kingdom as those between the mole and the mole-cricket."

"Indeed! What other theory can so well satisfy the demands of science?"

"The theory which lies at the root of all Monotheism, viz.: the origin of all things in One Divine Mind. The critic will trace with reasonable certainty the literary remains of an ancient author by the characteristics of style. Amid a number of claimants he will separate the genuine products from the apochryphal by those resemblances which naturally and inevitably mark the productions of one mind. Now, why should I not reason in this wise of the One Great Over-Mind and the products of His thought? Is it strange that, if all things are created by the Almighty God, there should be traceable amongst them even through an infinite wealth and variety of wisdom, taste and skill, a manifest likeness? Nay, it would be strange were it otherwise. Belief in the Unity of God the Creator leads logically to such analogies as we have been speaking of. Sometimes, as with our mole and cricket, the analogies lie close to the surface; again, they run deeper, or are wholly hidden even from star-eyed science. But, in any case, I cannot see, from this stand-point, that the theory of evolution has any advantage over a theory of special creations. However, there is no need that the two theories should fall to blows. Let us have Patience and Charity. There is a deal too much dogmatism on both sides. Let us wait and look further. Truth is one and

of One. By and by we shall find the links that bind all natural facts into one chain, and that shall lead—I never for a moment doubt it!—over whatever trail, by whatever method, straight to the Hand Divine."

The face of the good old man had kindled under the play of thought. He had brushed back his felt hat, as was his habit in animated conversation, until his broad brow was fully exposed. He walked on, erect and vigorous, punctuating his periods by sounding thumps upon the path with his gold-headed cane (another peculiar habit), keeping his eyes the while well aloft as though communing with the clouds. Gradually the glance fell until it reached the plane of my face, when, with a bright smile, the Doctor added:

"There, you have tempted me to express sentiments that I rarely trouble others with. You may put it down as one more of the wonders of that extraordinary mole-cricket that he should thus lift the flood-gate of garrulity from an old man's lips."

"My dear Doctor," I said, "I thank you from my heart for this expression of your views. It would be well for all concerned were such reasonable and charitable opinions more commonly held and frequently uttered."

"Now for the bumble-bees!"

The farm-house awoke from the profound stillness which, according to the law of the Mistress, daily invited to a refreshing afternoon nap. Abby and the children were home from school, Hugh and Joe were in early from the field, and I summoned all hands to the

FIG. 51.—QUEEN, MALE, WORKERS MINOR AND MAJOR OF HUMBLE-BEE (BOMBUS VIRGINICUS.)

raid upon the bees. The nest was found upon the lawn, just beyond the clump of shade trees where the yard begins to roll downward toward the meadow and the spring-house run. One of the gates opened directly into the sod by a circular hole, rimmed around about by excavated soil. It was prettily embowered beneath the tufts of orchard grass and sprigs of red clover, which indeed wholly concealed it.

"How cunningly this is hidden!" exclaimed the Schoolma'am; "pray, how did you happen to find it, Harry?"

"I jest stumbled on it, ma'am. I stopped here one

day, and while moving my feet back and forth, firs' thing I knowed two or three bees came up out 'v the grass and began buzzin' 'round me. I knowed what that meant, stooped down and found this hole."

"So?" said the Schoolma'am. "The bees then were themselves the tell-tales and betrayed their own nest They hadn't imbibed the peaceful principles of the old Friendly proprietor, or they might have escaped this impending doom. Heigh-ho!"

"Very likely, Miss Abby. But we can moralize by and by. Where 's your other nest, Harry?"

It was pointed out at the edge of an uncovered hot-bed which had been set into the bank about eight feet from the pretty gate which we had just examined and admired. A hole as big as one's fist penetrated the bank at the side of the bed-frame, into which several bees entered while we looked. The first opening was evidently the natural architecture of the bees, but this seemed to be the burrow of a mole which had been utilized by the insects. We decided to begin operations at the first gate. The party gathered around at various distances, regulated by the various degrees of respect entertained for the acculeate ability of the bees.

"Hello, Joe, bring on the jug!" called Harry; "we 're all ready."

"Jug? What's that for?" asked Abby.

"Dear knows!" said the Mistress; "but the boys have been exploring the premises for a black jug—it must be a black one, they said, or it wouldn't answer."

The lads had evidently succeeded in their search, for Joe appeared, carrying a black jug, half filled with water. He laid it on its side, with the mouth close to the gate.

"All right!" he said. "Go ahead now. I warrant the bees won't hurt us very much."

I thrust a tuft of cotton into the opening, and then cut out the sod around, thus preserving intact the natural gate to the nest. When this was removed, and the gallery beneath uncovered, the mystery of Joe's jug was immediately explained. One after another a troop of yellow-backed bees issued forth, mounted on wing with angry whirr, coursed a few narrow circles, then dived into the open mouth of the jug, where they were immersed in the contents.

"Oh, Joe," exclaimed Abby, "this is a base mode of warfare. It equals the wickedness of our white ancestors, who have literally exterminated the wild aborigines by the enticements of the jug. Fie! fie! Why don't you fight them like a man?" (Fig. 52.)

"Hugh Bond declared these bees trespassers," cried the Mistress from the safe shelter of a neighboring pine tree, "and I have heard him affirm that all trespassers ought to be 'jugged.' Don't mind what Miss Abby says, Joe."

"Alas!" said the Doctor, also inclined to draw a moral from the novel proceeding, "how often is Industry, symbolized by the busy bee, utterly wrecked, and its fruits desolated by the perfidious habit of which the 'jug' is the emblem!"

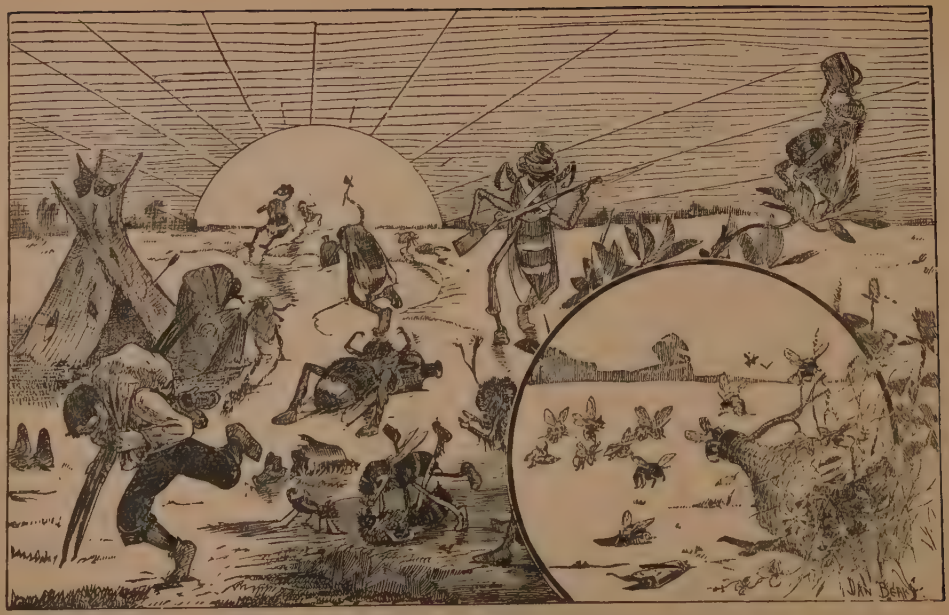


FIG. 52.—WILD ABORIGINES EXTERMINATED BY THE ENTICEMENTS OF THE JUG.—*p.* 155.

"Doctor, Doctor!" called the Mistress, "how dare you? That 's my vinegar jug!"

"Pardon, madam," said the Dominie, "I meant no harm; but I perceive that it is true, as our old writing-copy affirmed, 'Comparisons are odious.'"

In the meantime, quite unmolested by the bees, we had followed the underground gallery, which soon widened into what was evidently the burrow of a mole. It led in a zigzag course toward the hot-bed frame.

"Why, Harry," I said, "your two nests will turn out to be one, I think."

So it proved. After tracing the burrow for a distance of five feet, we came upon the nest. It lay in a cavity seven or eight inches in diameter, the floor of which was eighteen inches from the surface.

As the yellow cells of the bumble-bees showed amid the torn shreds of their gray mattress of curled hay, the boys cried out:

"Here it is! Here it is!"

The Mistress left the shelter of her tree, with head wrapped in a scarf; the Doctor pulled his hat-brims around his ears; Julia threw up her check apron until it wholly enveloped her head; Abby wore her hat, and had twisted a kerchief around her neck. What they saw through the broken wall of the cave was a round bundle of dry chopped grass, about the bigness of one's head, lying on the floor, sprinkled with the yellow soil fallen from our digging.

"Look out now!"

Half a dozen bees rose from the pulverized ruins of

their home; shook off the dust from their wings, and darted toward the group of curious observers. There were screams and a quick dispersion. The Mistress and Jenny ran away without ceremony. Abby took a step or two backward, and then stood her ground, taking the precaution, however, to clasp her skirts tightly, while her head rapidly oscillated in the vain endeavor to follow the insects' flight. The Doctor retreated with some show of dignity, as became his cloth, but hugged his cheeks tightly with his soft hat. Uuluckily for him, black seems to affect a humble-bee as red does a bull; and several of the irate workers, attracted by the clerical sable, charged straight upon the dominie. This was too much, even for his dignity; so, standing no further ceremony, he turned and fled, holding his hat down with one hand, and with the other wildly beating a handkerchief about his face. The scene was laughable enough, but the boys ran to the rescue. The bees abandoned the Doctor and fell upon them, but were soon beaten down by the paddles with which they were armed.

The danger was over, and the party returned with much merriment to the cave. The nest was taken out, laid upon a cloth, and the swathing of curled hay removed. This exposed a spherical cluster of oval-shaped cells about four inches in diameter. The cells were of various sizes; the largest not more than three-fourths of an inch long and one-half inch thick. They were made of thin yellow wax covered with brown blotches, and were so tightly fastened to one another

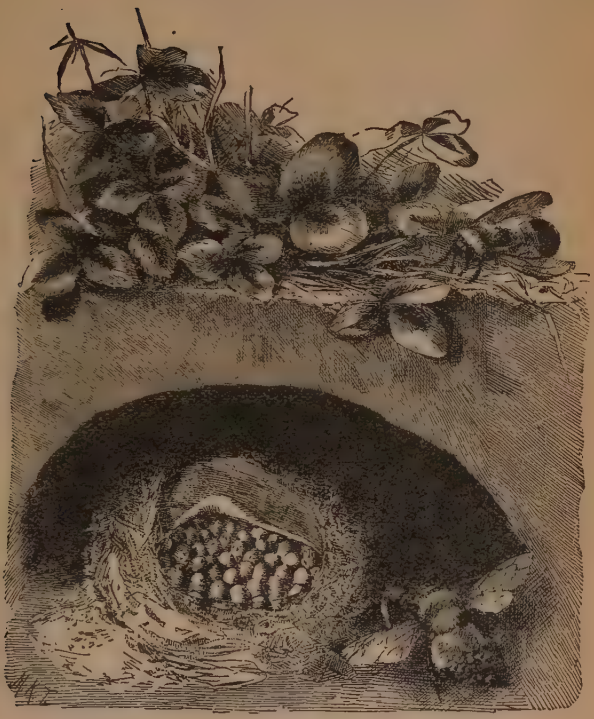


FIG. 53.—CAVE AND CELL-NEST OF HUMBLE-BEES.

by wax cement that they were separated with difficulty. Some of the cells were open ; most of them were closed. Of the latter some were filled with a number of small yellowish-white grubs of various sizes ; others contained but one grub each ; a large white one, which was doubtless a young princess in training for future queenship.

Here and there was a cell filled with yellow wax; and there were several small clusters of dirty gray cells filled with honey.

"Is that all there is of the nest?" asked Abby. Really, I am disappointed. This doesn't compare with the honey-bee's comb for beauty of structure."

"This is all; certainly the architecture cannot compare with that of the honey-bee, but there is much to admire in it after all. The humble-bee is not a child of civilization, and its ruder craft is very well adapted to its wilder life."

"Look at those cunning little bees," said the Mistress, "crawling over the cells. I suppose they are lately hatched and half-grown, and they don't seem to shun you at all! why is that?"

"You forget," I answered, "that there is no such thing as a half-grown bee except in the larval or grub condition. The larvæ feed enormously, but when they pass into the pupal state and transform, they come out into the imago or perfect insect, full grown. There is no increase in stature after that. These white-headed forms which you have called 'half-grown' are the small workers or minors. These, a size or two larger, are the male bees or drones. There is nothing very courageous in handling them, for they are stingless. Nature has left them absolutely without means of offense and defense."

"Look at them!" cried Abby, indignantly. "They are crawling around and around over the broken cells lapping up the honey! Stingless, hey? Lazy, greedy

FIG. 54.—THE DUDE OF THE BEEHIVE—POOR DRONE!

drones! See, too, how bright, clean and pretty they look—a sort of apiarian 'dude,' I do declare!"

"Come, come, Miss Abby," said the Doctor. "Everything after its kind, you know. Nature makes no mistakes even in the creation of drones.

CHAPTER X.

THE HISTORY OF A HUMBLE-BEE.

"I WONDER if we have killed the queen-bee? Ah, no! here she is, burrowed in the grass under the cells."

Disturbed by my intruding finger the royal lady issued from her retreat, and began promenading the top of the cells with restless steps. She was at least three times as large as the nurse-bees, being fully an inch and a quarter long. She was an object of great interest to all our party, and as she at once set to work, quite oblivious of our presence, to straighten out the damage done to the cells, she received numerous compliments whose edge was greatly sharpened against the disparaging contrast with the unfortunate drones.

"We are fortunate in possessing the queen," I remarked. "We can now hive our colony and observe the bees' habits more closely."

"Couldn't you have done that without the queen?" asked Abby.

"The colony might have kept together for a little while united in care of the grubs; but the queen seems to be the bond of union with these insects. The whole life of the family centers upon the rearing and care of the young, to which duties the queen-mother is very necessary. Besides, I fancy that her experience,

energy and aid are important factors in leadership and labor for the mechanical duties of the family, such as excavating and upholstering the cave and building the cells. But you shall have a chance to observe these matters for yourselves presently."

A rough hive was soon made as follows: One side of a small packing-box was filled with loose sods cut out in digging for the nest; the other side was partly filled with soil, on which the cluster of cells was laid in the midst of its swathing of curled hay. A large pane of glass was laid atop of this, leaving openings for the bees to escape into the air. The hive was placed near the original site of the nest, and we stationed ourselves close by to watch. As the afternoon was now well advanced some of the worker bees were coming home. They were utterly confused at not finding the gate of their nest, flew round and round, settled here and there in vain search and rose again to resume their restless circles. Not one entered the box until I finally removed the glass. In a few minutes thereafter half a dozen large workers, with the little bags upon their legs laden with yellow pollen, dropped into the nest and settled down beneath the cells without any sign apparent to us of excitement or surprise.

Meanwhile, however, the queen was laboring with vast energy. She seized bits and bunches of the upholstery in her mandibles, and pulled and pushed with her feet with the intention of burying the cells. Small workers, nurses or "minor workers," about half the size of the queen, who differed from the major workers in size,

being at least one-third smaller, followed the lead of the queen. There were few of them left, but they worked energetically. Then the big workers caught the infection. With the pollen still clinging to their legs, they laid heartily hold of the upholstery and dragged away along with the rest. They burrowed under the mass, and worked from beneath, pushing up the pliable fibres, pulling and tugging, scratching and kicking, the whole heap all the while gradually shifting toward and gathering around the cells.

"Look at that bee!" said Abby. "What is it doing now?"

A large worker had climbed upon the fresh cut edge of the sods that filled one side of the box. It seized bits of soil with its jaws and cast down pellets from the slope; it grasped the fine rootlets that everywhere interlaced the sod and bit at them with great fury.

"What can the creature mean? Is it insane with despair over the ruin of its home? Look! there goes another one. It, too, has been seized with the rabies."

A second bee had mounted the sod wall, and seizing upon the soil, cut out pellets with its mandibles until its head was buried. In went the short fore-feet, with which the insect dug like a dog in a rabbit-burrow. I took out my watch to time the insect miner, and in less than two minutes it had buried its entire body in the hole. (Fig. 55.)

"Dear me!" exclaimed the Mistress. "There is energy for you! That is certainly mining extraordinary. A Lehigh coal-digger or a Leadville silver-miner might

FIG. 55.— HUMBLE-BEE UPHOLSTERY—WORKER BURROWING FOR ROOTLETS, AND QUEEN COVERING HER NEST. FROM NATURE.

well envy such force and skill as these. What a pity it should be so ill employed, for this work seems utterly without purpose ; is it so ?"

"Wait a while," I answered. "Patience and watchfulness solve many mysteries in the behavior of nature. I dare say we shall by-and-by find some reasonable issue to this work."

So it proved ; for before the evening ended the mystery was disclosed. We discovered that the object of the bees was the garnering of the fine roots running through the sod. These were pulled out in quantities, raked down the slope by the hind feet, and added to the mass of upholstery. Next morning when I visited my hive I found the cells quite covered ; the summit of the

conical moundlet thus formed was composed of fine fibres of the excavated rootlets, while the edges of the sod were stripped of the same. Cells, larvæ, drones and queen were quite out of sight, buried and domiciled within the grassy mattress that bunched out above them. Here and there workers would push out their black heads from the mound, like boys playing hide-and-seek in a hay-mow, and pull them back again. Others would slowly scramble forth and busy themselves at tucking up the tufts of upholstery, or if my approach had been ungentle, would rise like alarmed sentinels and hum around the miniature hay-cock that held the treasures of their home. At several places in the mound the openings through which these bees came were well nigh formed into regular tubular gates by the compacting of the fibre.

"Come," said the Doctor, as we sat on the porch after tea, enjoying the soft autumn evening, "we ought to round out our bee-hunting with the story of how a nest is founded. What say you, Mr. Mayfield?"

"I am quite at your service, and the story is not long, though somewhat curious. At the end of fall nearly all the humble-bees die. The males invariably perish, but one or two of the females or young queens survive, and pass the winter in a state of hibernation. In early spring the queen awakes from her winter's sleep beneath the moss or leaves, or in deserted nests, or sheltered spots, such as hollow trees or hay-stacks.

"She may then be seen prowling above the ground, settling here and there, and flying off again with a

FIG. 56.—MATTRASS-MAKING.—"TUCKING UP THE TUFTS OF UPHOLSTERY."

monotonous, steady hum. Her secretiveness at this time is immensely developed, and the slightest suspicion of being watched will send her far off with an eager, angry flight. She will never dig an inch of soil as long as she sees any suspicious object, and will often make her way under a tuft of herbage, and remain there concealed until she fancies that danger has passed.

"Her resting place is frequently selected in the abandoned nest of a field mouse; sometimes beneath an old stump; sometimes, as with our nest, she sinks a tube directly into the sod, and avails herself of the burrow of a mole, either before or after, to secure entrance and exit to and from the cave which she digs.

Immediately she collects a small amount of pollen mixed with honey, and in this deposits from seven to fourteen eggs, gradually adding to the pollen mass until the first brood is hatched.

"She does not wait for one brood to be hatched before laying the eggs for a second. The eggs are laid in contact with each other, in one cavity of the mass of pollen with a part of which they are slightly covered. As soon as the larvæ are capable of motion and commence feeding they eat the pollen, by which they are surrounded, and, gradually separating, push their way in various directions. Eating as they move, and increasing in size quite rapidly, they soon make large cavities in the pollen mass. When they have attained their full size they spin a silken wall about them, which is covered by the old bees (after the first brood has matured) with a thin layer of wax, which soon becomes hard, forming the cells which we saw. The larvæ now gradually attain the pupa stage, and remain inactive until their development. They then cut their way out, and are ready to assume their several duties and stations as workers, males or queens. As the colony grows the nest is rapidly enlarged, until in the early fall it has grown to the size which we saw.

"In which estate," suggested Abby, "they are ready for the final and chief end of beehood—to yield a momentary pleasure to a destructive boy armed with jugs, paddles and wisps of hay."

"Or," I added, "to gratify the curiosity of a raiding naturalist and his friends."

"Well answered, Miss Abby," said the Doctor, "for you and I are *particeps criminis* with the boys and the naturalist, and are estopped from all complaint. Why is it that the humble-bee is such an Ishmaelite among the insects?"

"But *is* he an Ishmaelite?" I responded. "He is doubtless an Adullamite—a cave-dweller and a sort of outlaw; but while every man's hand appears to be against him, I cannot concede that his hand is against every man. He is a peaceful, well-nigh harmless fellow, and would do little damage were he let alone. When the scythe or mowing-machine rushes over his nest in the meadow-grass at hay-harvest, he makes a good deal of fuss, of course—as who would not under like circumstances? Sometimes he inflicts a sting; but these are not crimes sufficient to call down the universal wrath of man. As for the few cells of honey in his nest, they alone would scarcely tempt even boyhood to the onset. It's a case of persecution, and I speak a good word for our wild friends—the Indians of the bee race. I am not even sure that the humble-bee is not belied as to its stinging propensity. At least I have at various times sat down by a nest, quietly thrust in my naked hand, removed the mattress and examined the interior at my leisure. The bees bustled out and buzzed around, but I sat perfectly still and received no harm."

"Has the humble-bee any natural enemies?" asked the Doctor.

"Thank you for the suggestion—Yes! There is one, at least, whom I am glad to classify with its human

foes—the skunk or pole-cat. It is not a very goodly fellowship, certainly, but that is the fact, boys and pole-cats are fellow-soldiers in their raids upon the humble-bee. The skunk hunts the nests, and tears them up for the sake of the larvæ particularly, of which it is very fond. The nests of yellow-jackets, which are also made on the ground, are raided in the same way by this animal."

"Why don't the bees sting 'em off?" asked Harry.

"Doubtless, they do try; but the assaults are usually by night when the insects are a little dazed, and before they can recover from their surprise the mischief is done. Besides, the fur jacket of the beast is a good protection against so short a sword as a bee-sting."

"I should think," said Abby, "that the mere presence of such an ill-odored animal would suffice to disperse such respectable creatures as bees. Faugh!"

"But then," I answered, joining in the laugh which followed the Schoolma'am's closing interjection, "you must remember that the skunk is not always malodorous. Like some unsavory human kind, of whom I wot, it is by no means ill-looking, and knows how to conceal its obnoxious traits. The powerful perfume which it carries in the little pouch which nature has provided for that purpose, and which is the animal's weapon of defence, would not be used against such insignificant assailants as bees. That is used for more formidable enemies, as man and dogs. Besides, I have known very fastidious gentlewomen who could pat and fondle the skunk's soft coat with great pleasure."

"Oh, Mr. Mayfield!" cried Abby, "You are surely joking with us! How could they bear—"

"Come, come, my dear." interposed the Mistress, who at once saw the point of my quizzing. "you quite forget that the fur of our unsavory friend has been lately much used for ladies' muffs."

"I cry quarter!" exclaimed Abby, when the merriment had subsided, "I was fairly trapped. And now, as I am especially interested in changing the subject, please tell me how the skunk manages to get at the bees? If the nests are all hidden like this one just dug out by us, with narrow approaches several feet under ground, it would be a heavy task to burrow to them."

"I think I kin answer that question," Hugh responded, "fer down in the meadows, and in the tussocks along the stream, you commonly find 'em right on top uv the groun', in an old mouse nest, or a little hollow half 's big as one's head. They build ther combs in these hollows, and cover 'em with ther little straw heaps, an' seem to git along right well. Uv course, the grass shelters 'em a good 'eal. I never seed a nest like this un in the yard, down ther. I think, however, them 's a differt sort o' bees from these uns, ain't they? They 'pear bigger and yallerer."

"You have observed quite accurately, Hugh. My friend, Mr. Ezra T. Cresson, tells me that there are more than forty species of humble-bee known to inhabit North America. I have heard countrymen call the species of which you speak the swamp-bee; its scientific

FIG. 57.—APIARIAN ENEMIES AND FRIENDS.

name is probably *Bombus separatus*, Cresson. The species which we have been observing is *Bombus virginicus.*

"While speaking of the enemies of the bees, we must not forget to mention the field-mice, who, although they yield nesting material to their wild insect friends, make ample reprisals by destroying the honeycombs. The late Mr. Darwin made a curious allusion to this fact in his book on the "Origin of Species." We may infer, he says, as highly probable, that were the whole genus of humble-bees to become extinct or very rare in England, the heart's-ease and red clover (which they fertilize by carrying pollen from flower to flower), would become very rare or wholly disappear. The number of humble-bees in any district depends in a great degree on the number of field mice which destroy their combs and nests; and Colonel Newman, who has long attended to the habits of humble-bees, believes that more than two-thirds of them are thus destroyed all over England. Now, the number of mice is largely dependent, as every one knows, on the number of *cats.* Colonel Newman says that near villages and small towns he has found the nests of humble-bees more numerous than elsewhere—a fact which he attributes to the number of cats that destroy the mice. Hence it is quite credible that the presence of a feline animal in large numbers in a district might determine, through the intervention first of mice and then of bees, the frequency of certain flowers in a district! I do not know whether the above curious chain of facts holds equally

good in America as in England ; but it probably obtains to some extent, at least."

"Blessings on poor Tabby!" exclaimed the Mistress, stroking the sleek fur of the fine Maltese cat that lay purring in her lap. "Here is another to add to the list of your domestic virtues—we owe to you our beautiful red clover fields!"

"Yes," said Abby ; "but don't forget to dispense a little gratitude to the poor humble-bee, who is the principal benefactor, after all. I shall tell these strange news to my farmer lads, and try to persuade them against persecuting so useful a friend. But the average schoolboy, I fear, is proof against persuasion when a humble-bee's nest is in question."

"Perhaps," I suggested, "schoolboys are natural checks upon the undue increase of the insects, just as cats are upon mice. But let us take up again the construction of the bee's nest, whose description we had not quite completed. Hugh spoke about meadow bees weathering the season very well without any covering but the straw-heap and the overhanging herbage. There is something more than this. Do you notice in the nest which we excavated that a slight shell or casing at the right side of the cells was formed between the cells and the outside upholstery? This is made by spreading a coating of wax on the inside of the mat, which hardens around the straws and forms about the cells a waterproof envelope. The mattress may be removed from this without breaking it, leaving the cells quite inclosed by it. This is doubtless a valu-

FIG. 58.—CURTAIN OF WAX-WORKERS (AFTER RENNIE.)

able protection against the rain." (See Fig. 53, chap. ix.)

"Where do the bees get this wax?" asked Joe.

"A proper question, certainly; I wonder it has not been asked before. The bee secretes the wax from its own body. On the under side of the abdomen are six little flaps, not unlike pockets, the covers of which can be easily raised with a pin. Under these flaps is secreted the wax, which is produced in tiny scales or plates, and may be seen projecting from the flaps like little half-moon-shaped white lines. A scale of wax is drawn out from the abdominal ring by pincers fixed at the joint of one of the hind pair of legs, and is carried to the mouth. It is there worked up by the mandibles and tongue, and undergoes some important change. When secreting the wax the wax-workers of the honey-bees, at least, have a curious habit of hanging in a chain-like cluster, holding fast one another's legs. This is called a curtain.

Plenty of food, quiet and warmth are necessary for the production of wax, and as it is secreted very slowly, it is extremely valuable and used with great economy. *How* wax is formed within the body of the bee I cannot explain any more than I can tell how the liquid silk is produced within the spider's silk glands. The Author of Nature has endowed these creatures with such gifts and the power to use them—I go no further. But it is a wonderful substance; soft enough, when warm, to be kneaded and spread like mortar, and hard enough when cool to bear the weight of brood

and honey. Moreover, it is of a texture so close that the honey cannot soak through the delicate walls of the cells, which are perfect, natural honey-pots.

"Tell me something," said the Mistress, "of the way in which bees gather honey. I have often seen them humming around and diving into flowers, but they move so rapidly that I could never fairly observe their behavior."

"It is done in this way: the bee has at the end of its face a long, hair-clad proboscis or tongue which it inserts into the recesses of flowers, brushes out the nectar, passes the laden tongue through its jaws, (Fig. 59) scrapes off the sweet liquid and swallows it. Just within the abdomen the æsophagus expands into a little sac called the crop or 'honey bag,' and into this the nectar is passed. If the bee wants to eat, it opens a minute valve which divides the crop from the stomach, which is just beyond it, and lets out enough to satisfy its hunger. As long as the valve is closed the nectar accumulates, and when the crop is filled the bee flies home and regurgitates the collected sweets into one of the

FIG. 59.— FACE OF HUMBLE-BEE, SHOWING TONGUE, (FROM NATURE.)

honey cells. The liquid enters the crop as nectar; it comes out honey—by what process is a secret, even to the bee!"

"I don't quite understand that," said Harry.

"Then let me try to illustrate." I took from the table a drop tube or pipette, such as is commonly used by apothecaries and microscopists. It is simply a glass tube narrowed at one end and inserted into an india-rubber bulb. Pressing the bulb between finger and thumb, I plunged the tip into a tumbler of water, which as the pressure was removed rushed in and filled the pipe. "Observe now what happens," I said, holding aloft the charged pipette; "when I press upon this bulb every movement of my thumb and finger forces a drop of the liquid to gather at the nozzle of the pipette and finally to drip away. Do you understand how that happens, Harry?"

"Yes, sir, I think I do," rejoined the lad. "W'en you sqeezes agin' the rubber bulb it presses on the air inside, and that pushes agin the water in the pipe and forces it out of the nozzle."

"That's quite plain; is it?"

"Yes, sir; quite."

"Very well, then; let us suppose that this nozzle is the bee's mouth; this glass tube the bee's æsophagus, through which the nectar passes into this rubber bulb, which we will call, if you please, the honey-crop. Now our bee has a full crop and wants to get it emptied into the honey-cell. All she has to do is to squeeze the crop tightly enough."

FIG. 60.—MRS. BUMBLE FILLS THE HONEY JARS.

"Does she do it with her paws?" exclaimed the lad, his face all aglow with the interest and excitement of his new thoughts.

"Not quite that, Harry," I replied, smiling; "but that 's the principle. Instead of squeezing the crop with her hands, she causes the muscles which surround it to contract, and that presses tightly upon it. Just as my hand is opened and shut at once by certain muscles that expand and contract—thus!—so the bee's crop is pushed together and filled out again by the muscles that surround it. Now, suppose my fingers to represent those muscles; they tighten upon the crop—so! (squeezing the bulb), and then what happens?"

"I see it!" exclaimed Harry. "The honey is squeezed into the tube, and up, up, till it comes out uv the noz—the mouth, I mean—just like the water-drops. I understand, truly!"

"Does all honey go through that process—down the bee's throat and up again?" asked Abby.

"All genuine honey does. But over-fastidious people can find plenty of the counterfeit article. Though I am no wise certain that they will find anything that goes through a process of manufacture as thoroughly clean and wholesome as the original."

"We have had so many wonders this evening," said the Doctor, "that I am doubtful if we can inwardly digest much more; but there is one point further that I would like you to clear up for me. What is the bee-basket in which the pollen is carried home?"

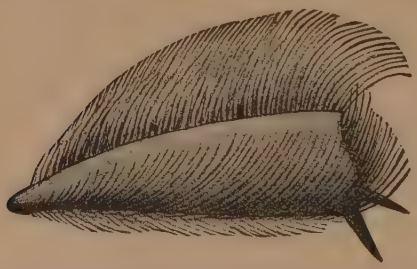


FIG. 61.—THE BEE BASKET (FROM NATURE.)

"I'd like to know 'bout that myself," said Hugh. "I've often heerd bee-raisers talkin' uv the 'basket,' and one day tried to study it out from some dead bees.

But nary basket could I see nuther on head ur tail ur back. That 's allus been a myste'y to me."

"Very well, then, my good fellow, I promise that you shall understand it this time. You all remember that I called your attention to the fact that some of the humble-bees that came in when we were hiving our captured nest had large balls of flower dust or pollen on their hind-legs."

FIG. 62.—HIND LEG OF A WORKING HUMBLE-BEE, TO SHOW THE BASKET. (FROM NATURE.)

"Yes, we remember that," answered Abby. "Some of them were yellow, others whitish and gray. Was that pollen?"

"That was pollen, and a brown, resinous substance called *propolis*, more tenacious and extensible than wax, and well adapted for cementing and varnishing. Here are several dead bees which I will pass around the circle. Now let us turn to our manilla 'black-board' on the table while I draw, much enlarged, one of those hind-legs. The shin or middle portion, you see, is flat, of a triangular shape, is smooth, shining and slightly hollowed on the outer side. This horn-like substance forms the

FIG. 63.—THE BASKET-BURDENED BEE COMES HOME.

bottom of the basket. Around the edges of this plate are placed rows of strong, thickly-set, long bristles, which curve inward. These are the walls of the basket, and there! we have the structure quite complete. Now take this pocket-lens and tell me if you see the basket upon those specimens of bees."

The Mistress and Abby, the Doctor and Hugh—all succeeded in making out the much talked of receptacle, and the rest were contented with the rough drawing.

"But how does the bee get her materials into her basket?" asked the Doctor.

"Ah, I was prepared to hear that. The material is collected gradually with the mandibles, from which the short fore-legs gather it. Hence it is passed backward to the middle-legs by a series of multiplied scrapings and twistings which I can't pretend to detail. In the same way it is sent back once more to the hind-leg, and is scraped and patted into the basket, where it is secured from falling out by the walls of bristles whose elasticity will even allow the load to be heaped beyond their points without letting it fall. When the busy harvester has gathered as much as her basket will conveniently hold, she flies away home and empties her load by a reversal of the process which filled it. In this work, however, she is often aided by her fellow-workers."

"I believe," said the Doctor, "that I better understand now the force of the verse concerning the bee which has crept into the Septuagint version of Proverbs, sixth chapter and eighth verse. This version was made from the Hebrew for the Greek-speaking Jews of Alex-

andria, but the verse has not been found, I believe, in the original text. It runs thus: "Go to the bee and learn how diligent she is and what a noble work she produces, whose labors kings and private men use for their health; she is desired and honored by all, and though weak in strength, yet since she values wisdom, she prevails." I suppose some bee-loving rabbi must have felt jealous of the prominence given to the ant by the Wise King and added a comment which future generations felt bound to accept as good Scripture. At all events, it is good sense."

"And yet," remarked Abby, "when a man lacks wisdom, is a bit hair-brained and visionary, we say that he has a 'bee in his bonnet.' How is that?"

"It is inconsistent enough," replied the Doctor; "but our Scotch friends are responsible for the proverb. I suppose it is a case of giving one a character from a single quality, and that by no means truly characteristic. Certainly, I at least shall think of something more than mere 'buzzing' when I remember the bee."

The full moon had now risen, and its silver light could be seen in the distance shimmering upon the broad Delaware and the Jersey coast beyond. The Doctor had declined our invitation to spend another night with us, and made ready to return to Marple. Followed by cordial good-byes, the good man, with his old carry-all and chestnut-bay horse, drove away under the moonlight, and the farm-house settled down to rest.

CHAPTER XI.

INSECT ENGINEERING—BRIDGE BUILDING AND BALLOONING SPIDERS.

OCTOBER is the golden month of the American calendar. There is an indescribable mellowness in the atmosphere, as though the year had centered all the luscious fruitage of her ripening upon this halcyon season. The air is warm, but crisp with ozone. At times the sky is clear as in midwinter; again the landscape is wrapped in a soft haze through which distant objects loom with indistinct outlines like the remembered objects of one's dream. All healthful life in Nature finds a joy in very being, none the less because there hangs upon all things a prophetic tone of coming dissolution. The melancholy days are not yet quite "come," but are coming, and are near. The leaves are adding to their summer green the first tints of russet, yellow, and scarlet that shall by-and-by enfold them in their dying glory. The insect-world is still full of life; but already in many species motherhood has paid to posterity the last penalty of Nature, and in many others the reservoirs of life are running low. But the waning and the waxing of life go on together. Parents are dying, but children are gaining in vigor. Multitudes

have been seized by the strange instinct of migration, and are being swept by its resistless force into the currents of a new and independent existence. And thereby hangs the tale which this chapter is in part to unfold.

On such a morning as I have described Dan entered the kitchen precincts with a rueful face.

"W'at's the matter?" asked Sarah sharply. "You look like the final judgment had come. Is your ole woman dead, or 've ye lost your 'baccy pouch?"

"Dar's no 'casion for levity, Sairy Ann," said the old man solemnly. "T'ings 's bad nuff, and y 'll see it byne by."

"Goody gracious me! Do speak up, man, and let 's know the wust on 't at wanst! W'at 's happened?"

"W'y sumfin mighty awful 's happen'd. I cl'ar to goodness dat Mars Mayfield's done gone—cl'ar—crazy!" Dan lowered his voice, and spoke in a husky sort of a growl which he doubtless meant for a whisper.

"Crazy?" screamed Sarah. "W'at on airth—" She stopped short in her sentence, for at that moment the Mistress entered the room. She had heard the ominous word on Sarah's lips and saw the terrified look upon both countenances. Her face blanched, and she sank into a chair overcome by an indefinable dread of some unknown peril. Her thoughts had run directly to her husband, who an hour or more ago had gone into the fields. Many readers will sympathize with the Mistress, though none, perhaps, can give any better reason than she why such unreasonable anticipations of evil to

the best beloved should inevitably arise on occasions of sudden alarm.

The Mistress is not a woman to give way long before an unseen trouble. In a moment she had rallied, and demanded the cause of the excitement which she had witnessed.

Dan doffed his hat, thrust his great gaunt hands through his matted hair, and began a stammering explanation.

"W'y—w'y, you see, Miss Mayfiel', I war gwine froo de meadow while ago, and I sees Mars' Mayfiel' out dar standin' by de fence-pos'. He had 'is little spy-glass'n 'is 'an, and wur a-spyin' somethin' 'r odder. Jes den—"

The Mistress started to her feet.

"Has he been hurt? Tell me!"

"Hurt? No, miss, not a' tall; nuffin 'v the kin', I do shore you. 'Z I wur sayin', jes den I seed 'im jump de fence like a wil' colt an' break off ober de meadow like mad. He ran back and forrud, zigzaggin' across de fiel' in de mos' cur'us way. Den he stopped stock still, and went back to de fence and spied at another pos', and off he goes ag'in *like mad*—"

The old man emphasized the last word, cast a peculiarly sad look toward the Mistress, and then went on, with the circumlocution which his tender heart had suggested:

"Off he shoots agin, I say, jes like mad, and goes froo wunst more dem wild zigzaggin' motions. I stood 'n watched 'im a w'ile, and then, clar to goodness,

Misses, I done got right sick a seein' poor Mars' Mayfiel' tuk that a-way—so cur'us like—'s tho' he'd done loss 'is senses, and so I jes come straight home, and—"

"Oh, fudge!"

The Mistress broke in abruptly upon Dan's story. Her face had undergone a strange transformation as the narrative proceeded. Its whiteness slowly flushed into crimson; its lines of anxiety gradually relaxed into curves of mirthfulness. Then came another change—tears mounted to the eyes, and, as they trickled out upon the cheeks, Dan had reached the climax of his story, and the good woman broke out into her hysterical cry of mingled anger, amusement and joy. Without another word she turned and left the kitchen, leaving Dan overwhelmed with amazement.

"Lawh bress yer, honey!" he said at last. "De news 's been too much for her. It 's done turned her own head, too!"

Sarah was not much clearer than Dan in her view of the situation; but she saw, at least, that the old servant had made some sort of a mistake. She, therefore, came to his relief in her usual sharp way.

"There, Dan! Go 'long, now, to your work. You've been makin' a fool 'v yorself agin', 's usual. An' w'at's wuss, you 've gi'en the Mistress a powerful bad skeer. Purty feller you are, makin' out that your betters is crazy! I reckon you 're an old crank yourself, an' orter been sent to the 'sylum long ago. Go 'long, now, to your work!"

The irate cook flourished her pan so vigorously that

Dan thought her advice was worth heeding, and walked off slowly, shaking his head, and muttering "'Bout half de worl' is half cracked, anyhow, an' dat ole Sairy, de cook is de wuss one among 'em."

This is the story that the Mistress had to tell when we had drawn up our chairs to the sitting-room table for the weekly conversation about our insect Tenants.

The subject was Insect Engineering, and some of my field studies of the æronautic flight of spiders, by way of preparation for our talk, had been the cause of Dan's alarm.

"Well, Dan," I said, for the old man was at his chosen seat on the cricket by the inner door, and appeared to enjoy the Mistress's account of his blunder as much as the rest of us, "you 're not so much to blame after all. I can easily think that the strange attitudes of an entomologist, while in hot pursuit of his favorite study, would appear to persons who know nothing of his tastes and habits like the wild behavior of a madman. Besides, it is not the first time that I have been thought a little unsound on account of my natural history studies. Years ago when I first began to follow my specialties with some zeal, our good Mistress there—as she afterwards told me—spent many days in anxiety, and passed many hours in tears over what she supposed a development of insanity."

"Why, Mrs. Mayfield," exclaimed Abby, "could you have been so foolish?"

"It was even so," wife answered, "and the recollection of that fact proved a great comfort to me this

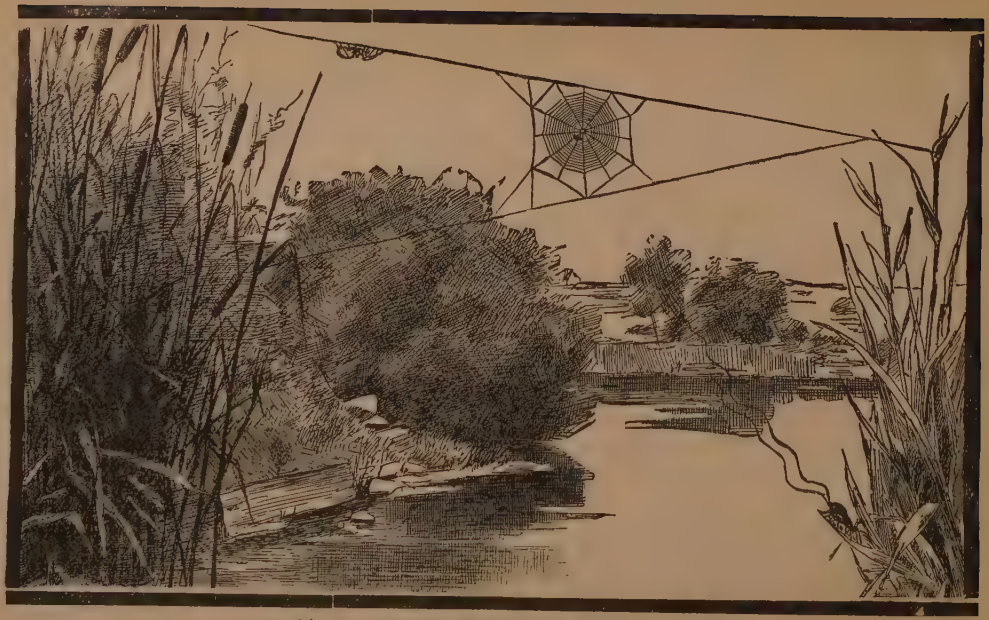


FIG. 64.—A SPIDER'S SUSPENSION BRIDGE.—*p.* 192.

morning; for it helped me to interpret the behavior that led Dan quite astray."

"I am reminded," I remarked, "of an incident related to me by Professor Hayden of the Geological Survey. One day while engaged in geological studies on the great American plains, he found himself widely separated from his party, and started out in search of it. Presently, the outlines of human forms appeared upon the horizon, and thinking them to be his friends he turned his steps toward them. As he drew nearer he perceived that they were a band of Indians. Greatly alarmed, for there were hostile tribes in the vicinity, he turned and fled. But the Indians already had seen him. At best he was no match in speed for them, but he was now weighted down with specimens of various rocks and fossils, and was soon overtaken and surrounded. He was bidden to dismount, and immediately the savages, who had also dismounted, began to strip him of his personal possessions. Knife, hammer, watch, disappeared. Then the red hands were plunged into his pockets and withdrawn full of—stones! Again and again this was repeated; pockets, pouch, saddle-bags, all were emptied, and, as the pile of rocks grew upon the ground beside him, his plunderers broke into a loud laugh. Then they looked at him carefully, touched their foreheads significantly, as much as to say "he is crazy," and with that strange reverence for the insane, which characterizes our American Indians, they respectfully returned to him all his goods, mounted their broncos and rode away. I suspect that the savages are not

the only persons who reason that one who can devote himself to collecting "rocks and bugs" is crazy. For my part, I have about concluded that I was much nearer perfect sanity in the days spent as a naturalist than afterward, when breaking down my health by hard work in collecting a fortune."

"But tell us," asked Abby, "what you were doing in the meadow when Dan saw you. I don't wonder, if his description is correct, that he did think you a little 'cur'us.'"

"Dan's description," I replied, laughing, "was a very good one, from the standpoint of an outside observer. The explanation is this: I had stationed myself by the fence to watch the 'flying spiders' as they are popularly called. This has been a golden day for the young balloonists, and they have been improving it finely. As I walked out this morning I saw long, white filaments of silk streaming from fence-posts, tall stalks of grass, clumps of weeds, shrubs, almost every elevated object in the fields. I knew by this token that the balloonists were abroad and busy. As I passed the Run I saw just at the point where it widens into the little pool an object of great beauty. It was a tiny and delicate, but perfect and quite strong suspension bridge." (Fig. 64.)

"A bridge!" exclaimed Abby. "It is some of Harry's work, I warrant. He is the handiest boy in school with his jack-knife, and beats even our New England lads, which is saying a good deal."

I smiled and glanced at Harry, whose face colored

under his partial teacher's praise. "Well, my boy, what say you? Was it your work?"

"No, sir; I never! I've got a 'flutter wheel' up there by the riffles, but nary bridge. I dunno who did it at all."

"I quite believe you, Harry. Let me show you how the bridge was made, and that will help us to find the architect."

In lieu of a blackboard I had provided a package of wide Manilla wrapping-paper and crayons. These served admirably for the rude outline sketching, by which I hoped in future to make our conversations somewhat more interesting to a mixed company, such as ours.

"Here is the run; on this clump of cat-tails was fixed one of the anchorages; on the opposite bank, a-top of this cluster of flags, was the other abutment. Here from side to side was stretched a foundation line, and just below it another."

"What sort of stuff were they made of?" asked Hugh Bond.

"To be sure, I should have mentioned that before. They were silken lines. Between the two, near the middle point, was constructed a series of truss-like supports, something like this."

The family group had gathered about the table, and bent over, eagerly watching the movements of my pencil. Before I had finished the sketch two or three voices exclaimed in chorus:

"A spider's web?"

"Yes, the snare of an orb-weaving spider. That is the suspension bridge which attracted my attention this morning, and I certainly think it a very pretty and ingenious one. A little further down the stream where the bank rises higher and is crowned on either side with sumach and blackberry vines, another orb-weaver had stretched her cables, and when I first noticed her was running along one line toward the center. She hung, head downward, and moved one leg after another in a hand-over-hand sort of way. When she reached the middle point of the line, she began spinning a round web like this which I have drawn."

"How did she git those lines across the run?" asked Hugh; "that puzzles me. She didn't swim across with it, I reckon? Though I have seed spiders swimmin' or runnin' on the water."

"Not this kind, Hugh. Our spider laid the main cables of her bridge in a quite different way. The fact is she proceeded much in the manner of Charles Ellet, the engineer who built the first suspension bridge over Niagara river in 1840. The first difficulty to be overcome was to get a string across the chasm. A reward of five dollars was offered for the first string landed on the opposite shore and this brought a host of kite-flyers to the scene. The kites fluttered like a flock of birds across the whirling flood and soon entangled on the bank beyond. The first string thus stretched, a wire was next drawn across, and heavier wires in succession followed until the great foundation cables were laid at length, and thence the weaving of the substantial wire

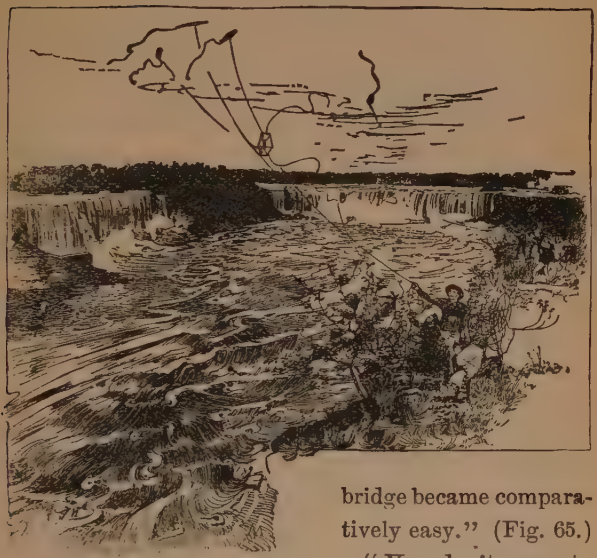


FIG. 65.—KITING THE CATARACT.

bridge became comparatively easy." (Fig. 65.)

"You don't mean to tell us that spiders really fly kites?" asked Abby rather doubtingly.

"Well, it amounts about to that; although, properly speaking, they fly cords instead of kites. As a rule, there is no object at the end of their lines which corresponds to the kite itself, although I have sometimes seen even that closely represented by broadened bits of silk, hammock-shaped ribbon, attached to the filaments spun out by orb-weavers when preparing for æronautic flight. However, the principle upon which a spider stretches her bridge-lines across a stream, or practices ballooning, is precisely that upon which American boys and Chinese men fly their kites; so that the engineer of

the Niagara bridge and the spider-engineer of the silken bridges over Townes' Run operated upon the same principle."

"But tell us how it was done," said Abby. "I haven't the most remote idea how such a creature can fly either a 'kite' or a 'string,' much less how it can go 'ballooning.'"

"I will do so, and that brings me to the starting point of Dan's morning experience. When he saw me I was standing by a fence-post watching a small saltigrade spider mount into the air. Its head was toward the wind, its eight feet spread out in a circle, its abdomen turned in the direction of the wind and elevated about 45°. From the little rosette of spinning mammals at the end of the abdomen issued several very delicate filaments which were caught by the breeze and floated upward to the length of several feet. The legs of the animal gradually bent backward and downward, and then—pop! with a quick vault the wee creature was off and away. (Fig. 66.)

"I leaped the fence, followed at full speed, trying to keep my eyes upon the æronaut, which, of course, at times compelled me to run back and forth, and at zigzag, as Dan put it, over the meadow. This had to be repeated with a number of specimens; but in the course of the morning I succeeded in confirming and completing observations which I had made years ago."

"But, tell us," Abby asked, "how the spiders got started in their flight over the meadow, and what that has to do with your suspension bridges?"

FIG. 66.—BALLOONING OR FLYING SPIDERS.

"Pardon me. I had taken too much for granted, I see. The spider, clinging to the post, sets its spinning apparatus in operation; the liquid silk, as it issues from silk glands through the many tiny tubes on the spinnerets, is immediately hardened at contact with the air, is caught by the wind and drawn out into long threads. Presently enough thread is spun out to overcome by its

buoyancy the weight of a spider, precisely as the buoyancy of a balloon overcomes the weight of the æronaut and his car, and permits them to ascend into and float upon the air. At that moment, which the spider recognizes by the upward traction of the threads, she leaps up and is carried off in the direction of the wind. Immediately after mounting she turns around, grasps her thread-balloon with her feet, spins out a little basket or mesh of connecting lines which her feet clasp, and then emits from her spinnerets another pencil of delicate threads. She now rides on a tiny net, hung back downward between the two long, floating filaments, and is carried before the wind 'where it listeth,' until the balloon strikes and entangles upon bush, tree, or other elevated object, when she dismounts and sets up housekeeping for herself."

"Have the spiders any control of their own descent?" asked Abby, "or are they wholly dependent upon the action of the wind?"

"I should have answered, before this morning, that they are entirely at the mercy of the wind. But I have now seen that which changes my opinion. One of the balloonists whom I carefully observed to-day, secured its own descent by gradually drawing in the floating lines until they gathered in a minute white pellet above the mandibles. As the lines shortened the buoyancy decreased, the weight of the spider yielded to gravitation, until gradually she was drawn to the ground and alighted on the grass. If this observation shall be confirmed as a truly typical one, we must concede

FIG. 67.—BALLOONING SPIDER PREPARING TO ASCEND.

that the little aranead produces, by lengthening her lines, a result similar to that of the human æronaut who throws out his ballast of sand; and, by gathering in the lines, accomplishes what ballooning man performs when he pulls the valve and permits the gas to escape."

"To return to our bridge. The orbweaver when

building a snare proceeds, in the main, after the manner of the ballooning saltigrade. She stations herself upon a leaf or branch, or top of a twig, opens her spinnerets and emits a thread which the wind takes up and carries out until it entangles on some adjacent object. At other times she drops from her perch, spinning after her a thread, to the end of which she hangs in a little meshed basket rapidly woven. While swinging in this position she emits her trial lines as before.

"Now, let us suppose our orbweaver seated upon this tall cat-tail, seeking to make her web (Fig. 67). The wind blows straight across the Run, and carries out her thread. It catches upon the opposite clump of flags, a fact which the engineer at once perceives, and draws the line taut. She pulls upon it with her feet to test it, then ventures upon it, and rapidly runs across, dragging after her a second cord, which unites with and strengthens the first.

"I chanced to be in New York when Farrington, the engineer, made the first voyage upon the initial cables of the Brooklyn bridge across the East River, and, upon invitation of a friend, went down to witness the transit. As I watched the bold fellow hung far aloft and moving above the sea waves beneath, I was so forcibly reminded of this behavior of my spider friends which I have just been describing, that I could not forbear pointing out the likeness to my friend, a distinguished engineer, very much to his disgust (Fig. 68.)

"The cable which the spider has thus formed is strengthened by several overlays, made in successive

FIG. 68.—THE ORIGINAL BROOKLINE BRIDGE.—"ENGINEER ARACHNE MAKES THE FIRST CROSSING."

trips back and forth, until it is strong enough to serve as a foundation cable. A second cable is stretched in a similar manner, and then the little architect proceeds to weave in her snare."

"How long are those foundation lines?" asked the Schoolma'am.

"That depends upon the direction of the wind and character of the site. If there are elevated objects

quite near in the direct course of the threads the lines will soon entangle and be short; but if there be a wide, open space before the lines they will stretch out for a goodly distance. Our Townes' Run bridge cables were not above ten feet long, but I have seen such lines twenty-five, thirty, and even some of forty feet in length stretched from tree to tree across a country road."

"I mind seein' one, sir," said Hugh," right here on the old farm much longer than them. I was crossin' the yard a leetle arter sun-up w'en I seed suthin' glintin' in the air like a fine wire. It stretched from a bush, aside the kerriage-entrance, across the track. I didn't see the ends of the thing, just the middle part, and I thot at wunst that some rascal had been stretchin' a wire across the road to knock off the hats of horsemen—it was about that height. I was mighty angry, 'v course, and went to pull down the wire, w'en lo, an' behold, it wur a spider web! I felt powerful small at bein' fooled so, but somehow the thread seemed magnified by the sun, an' I only seed it now an' ag'in as the light twinkled on it. However, I concluded to measure it. I followed it with my eye clare to the top 'v the old sycamore tree, and calkerlated that it was more 'n a hundred feet long. I never thot much about it, and never said nothin' till now. I 've often seed them stringin' webs around the place, but never one anythin' like 's long as that 'n. I never know'd how they wur made nuther; an' I 'm very much obleeged to you fer tellin' us."

"And for my part, I am greatly obliged to you, Hugh, for your fact, which is really a valuable contribution to our knowledge, as I also have never seen nor heard of a spider's bridge-line as long as the one you describe. There are many such facts, by the way, picked up by non-scientific observers in ordinary life, which would be of greatest value to the naturalist could they be made known.

"While we are on this subject I may say that young spiders often manage to string out structures that oddly resemble a bridge in miniature. After emerging from the egg-nest or cocoon, they spend a short season in colony, hanging together in little balls. (See chapter iii.) Soon they begin to move, and as they go they drag after them fine filaments of silk. A hundred spiderlings, more or less, passing from point to point, and back and forth among the bushes by single bridge-lines, and keeping close together, will not be long in laying out a series of lines and ribbons that remind one strongly of the roadway, trusses and cables of a bridge. One of the most curious miniatures of this sort which I have known was once made in my study. A package of cocoons, spun by an orbweaving spider, sent me from California, was laid upon my table. One morning upon entering the room, I found that the spiders had hatched and issued from the perforations in the lid of the package, which was a large cylindrical tin fruit-can.

"From the summit of this can, as from a bridge-pier, the spiderlings had strung their lines to books and

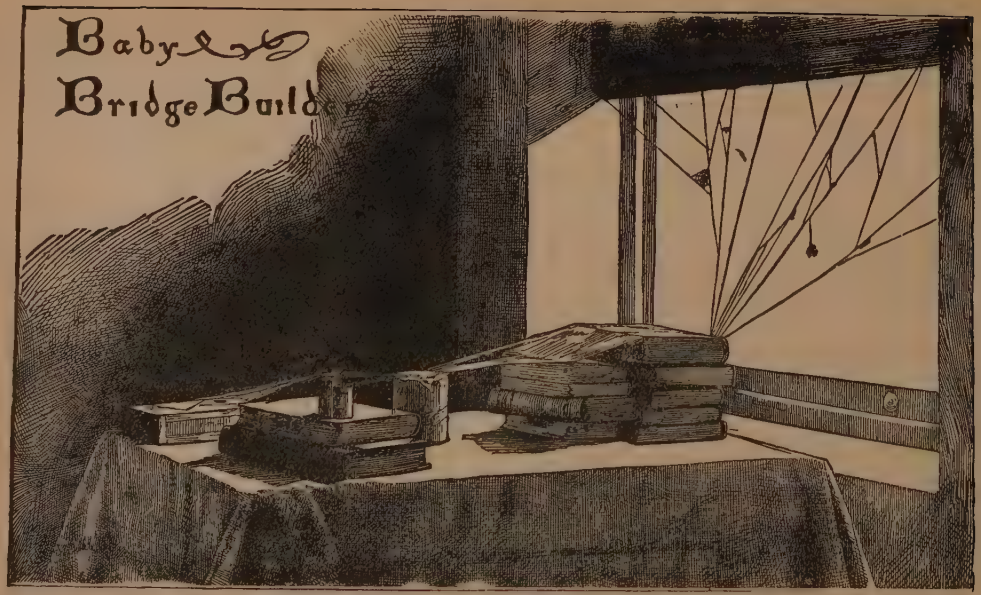


FIG. 69.—SILKEN BRIDGE BUILT BY BABY SPIDERS.

paper boxes laid along the table, and which thus formed a series of piers and abutments. They had already woven a sheeted way, several inches wide, that stretched above the middle of the table for five feet. Thence it spread upward to the window curtain in diverging threads, among which many of the wee adventurers hung (Fig. 69.) I kept the bridge for several days, during which time the "roadway" received many additional strings, and some of the baby bridge-builders spun delicate little cob-webs along the edges and among the trusses of their bridge, and separating themselves from their fellows, set up housekeeping for themselves."

CHAPTER XII.

ARGONAUT AND GEOMETER.

"WHY should your engineer friend have been disgusted at you for pointing out an analogy between the works of man and those of the spider?" asked Abby, abruptly. "For my part I think the likeness is very remarkable."

"Precisely my thought," said the Mistress. "It is wonderful! It seems incredible that such human-like behavior should belong to so lowly a creature. I verily believe that I shall never again brush down a cobweb without compunction!"

"I count that saying a triumph, indeed," I remarked with pleasure; "coming as it does from one who is the pink of perfection as a housekeeper, and withal full of natural prejudices against 'bugs,' it shows how much prevalent dislike of the living things of nature arises from lack of knowledge of their interesting habits.

"I am happy to say that my friend, the engineer, soon came to the same view. He had concluded hastily that I had belittled the greatest engineering work of the age by an unworthy comparison, and the suggestion that man had been the copyist of the aranead. On the contrary, I showed him that these were only indications, independently reached of the one great Over-mind of

nature, working similar ends by analogous principles of action implanted within creatures most widely separated in organization and endowments. Surely there could be nothing humiliating in that?"

"We were presently joined by a party of gentlemen, among whom was one of Mr. Roebling's assistants upon the Brooklyn Bridge. He was greatly interested in our conversation, and I ventured to carry my analogy a little further. This gentleman, on a previous occasion, had given me a detailed account of the building of the caissons upon which the immense stone piers had been constructed. I asked him:

"Am I right, Mr. Assistant, in supposing that the principles upon which these caissons have been built are those of the diving-bell and compression of air?"

"Yes; I suppose that we might say that very truly."

"Well, then, I will venture to say that I can find the same principles embodied in, I will not say anticipated by the work of a spider.

"Well, sir," said the Assistant, "you may, doubtless, succeed; but haven't you undertaken a pretty heavy contract?"

"You shall judge the issue. Here now," taking a note-book from my pocket, "is a rough sketch of the cell or nest of the water spider (*Argyroneta aquatica*), which is found in some of the streams of England. It is an egg-shaped silken sac, about the size of an acorn, which is woven upon water-plants underneath the surface. In the bottom part of the cell is a small circular opening. The cell, as first woven, is simply a

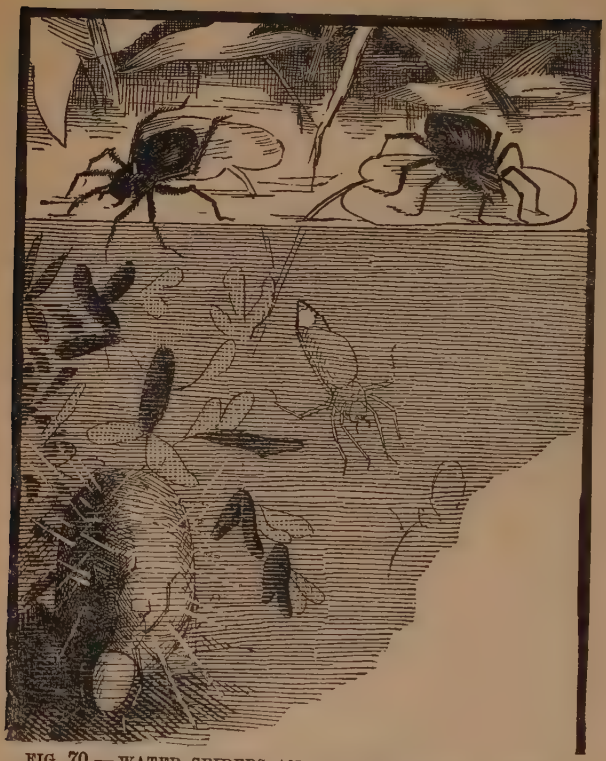


FIG. 70.—WATER SPIDERS AND THEIR EGG-SAC CAISSON.

flat, empty sac, with the mouth downward, and as the spider is an air-breathing animal, is, of course, useless as a domicile in that condition."

The gentleman followed my sketch with as much interest as you all show in this crayon outline. (Fig.70.)

"Now, look here!" said my friend. "You're not

going to tell us that your spider will introduce air into that cell?"

"That is precisely what I shall tell you. Can you guess how it will be done?"

"I have been trying to think; but I haven't the remotest notion how the creature could proceed. I can't imagine what implements it possesses for inflating such a structure in such a site."

"It is done thus: The spider ascends to the surface slowly, assisted by a thread attached to a leaf or other support below and at the surface of the water. When it nears the top it turns, with the extremity of the abdomen upward, and exposes a portion of the body to the air for an instant. Then with a jerk it snatches, as it were, a bubble of air, which is attached beneath to the hairs that cover the abdomen, and is held from above by the two hinder legs, which are crossed at an acute angle near their extremity. This crossing of the legs occurs at the instant the bubble is seized. The little creature then descends more rapidly than it mounted, regains its cell, always by the same route, turns the abdomen within the mouth, and disengages the bubble. This is repeated many times until the sac is filled and rounded out with air. This cell serves the water spider as living-room, dining-room and nursery. Here she spins her saucer-shaped cocoon, fixing it against the inner side of the cell near the top. Out of it, by and by, issue a hundred spiderlings, who spend their babyhood in this ingenious home, literally

'Rocked in the cradle of the deep.'

"Now, gentlemen," I asked, "have I proved my proposition?"

"You have come pretty near doing it, at all events," said the Assistant.

"Truly," said my friend, "if your facts are quite authentic, as I am bound to believe, your spider pets are worthy an honorary place in the guild of civil engineers. Indeed," he added, laughing, "I think that I shall suggest this animal as the most suitable emblem for our Philadelphia Engineers' Club."

"I am sure that we all agree with those learned gentlemen," remarked Abby.

"Thank you," I returned; "I think I shall confirm your good opinion by going back to the geometric spider, whom we left crossing her completed bridge-cable to begin the building of her snare. The manner in which this is done is most interesting, especially to one who has a taste for mechanical work. A point near the center is usually chosen—though not always—and the spider proceeds first of all to lay out an irregular polygon of lines which serves as the foundation or frame work of the orb. Here it is," pointing to the crayon figure sketched upon the paper; "and you can see that such an arrangement adds to the elasticity of the orb, and so increases its power to resist the force of the wind and of struggling insects.

"Next our engineer proceeds to lay in the radii or 'spokes' of her wheel-shaped web. I do not mean to say that she has an invariable order of action, but commonly she will start with a central diameter; as *a c*

(Fig. 71), at or near the middle point of which she gathers or spins a little tuft of white silk, which I mark H. From this point she proceeds to put in what we may call her first radius, H K. I will draw this figure (Fig. 72) to show how this is done. She drops her spinnerets upon the central tuft (H), and draws out a line which she seizes by one of her hind claws and holds out from her body. She then begins to ascend the upper part (a) of the diameter *a c*, and thence passes along the inner foundation line *K* (*K i*, Fig. 71) to the point K. All this time she drags after her the line which I represent by this dotted line *x*, holding it far enough aloof to keep it from entangling with the thread over which she moves. At K (Fig. 72) she stops, pulls this dragline taut, fastens it down to K, and thus has her first radius *K e H*. She now returns to the middle point H, either along the new radius *e*, or by the round about course of *K* and *a*. Her next radius is laid in precisely the same

FIG. 71.—PUTTING SPOKES TO THE WHEEL.

FIG. 72.—THE FIRST RADII.

way, except that it is spun on the opposite part of the snare. Thus, returning to our first figure (Fig. 71), she will start from H *down* the diameter *a c* to the line *m n*, dragging after her, as before, a loose thread which she tightens, fastens here at *n*, and thus gets her second radius. Hence, she will make the radii *H i*, *H m*, *H b*, and so on, around the circle."

"I notice," said Hugh, "that you have drawn those spokes alternately. That is, you put one on this side above, and the next on the other side below. That looks mighty workman-like, sir, jist as though a mechanic had laid it out. I've done a good deal in tinkerin' at carpentry myself, and ef I were building that kind uv a concern with lumber, or rope, either, I reckon that's jist the way I'd set to work. Does the spider go at it in that judgmatical style, or is it only your way uv puttin' it to us?"

"I am glad you raised that point yourself," I replied, "for I had intended to notice it. The spider invariably puts in her radii in that manner, laying them by what I have called alternate apposition. I will illustrate this by another figure. I once watched an orb-weaver throughout this part of her spinning-work, and drew out my note-book and numbered the radii as they were made. Before it occurred to me to do this, the lines A, B and D had been spun. The others were placed in, in about the following order: First, H1 (Fig. 73); then, on the opposite, H2. Next, again opposite, you see, H3, and after that H4, 5 and 6, 7 and 8, 9 and 10, and so on through all the seventeen radii which I counted.

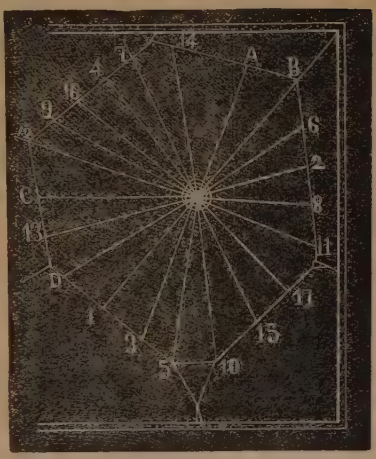


FIG. 73.—ALTERNATE APPOSITION.

You observe that there was a continual alternation of the lines, and for the most part a double alternation—that is, they were opposed to each other not only as to the sides—right and left—but as to the top and bottom. You can all see that this order kept the web equally braced and well trimmed from the beginning to the end of the work."

"I see that very clearly," remarked Abby, "although I confess that I have little taste for mechanics. But that isn't all of the web, is it? Where are the little ladders that run up and down from the center? You pointed them out to me in the snares of Bank Argiope and Caudata. Besides, I remember them by some of my experience in broidery, as this kind of snare has been very popular in fancy needle-work."

"The 'ladders,' as you call them, the spider makes immediately after the radii, and there is proof of good engineering in this part of her work also. When the radii are quite done she braces them around the ends,

where they converge upon the center by a series of spiral lines. Then she prepares to put in the rounds of her 'ladders,' which, however, are one continuous line that passes spirally across all the radii a number of times, thus forming a series of concentric circles.

"These spirals are often very numerous ; I have found as many as fifty or sixty, but generally the number does not exceed thirty. They are covered with minute beads of a very sticky substance, which give to the web its efficiency as a snare. Insects flying against the lines are immediately entangled, and before they have time to struggle free, the watchful spider pounces upon them. As the subsistence of the aranad depends upon these spiral lines their structure becomes a matter of great importance, and is conducted with becoming care.

"First of all a foundation or frame-work is spun, which we will call the spiral foundation. This consists of several concentric lines, usually about six or eight, which are also spirals, but are quite dry, that is, without viscid beads. The spider attaches a thread a short distance from the center, and moves around, crossing the radii at each circle a little further toward the circumference until she has covered sufficient space. She thus produces a series of spirals whose bounds mark out the surface over which her beaded spirals are to be spun.

"Here, for example, we have our radii, braced by these cross lines marked Z (Fig. 74). Here at O the

FIG. 74.—SPIRAL FOUNDATIONS—PUTTING IN THE SPIRALS.

engineer begins and moves upward (we will say) and outward until she spins the lines marked I, II, III, IV, etc. These are the spiral foundations. Now the movement is reversed. The spider begins at the outer margin of her spiral foundations, and from that point carries a line around, moving at each round a little nearer the center. She stops at the inner line where her foundation spirals had begun (I, Fig. 74). The series thus formed constitutes the spiral space, and the lines of this space are the 'rounds' of what Abby called the 'ladders.' In fact, a section of this part of the web is quite like the shrouds or rope-ladders of a ship. But woe to the voyager who tries to climb them! They are covered with a substance as sticky as that which has given the ancient mariner his favorite nickname of 'old tar,' for these are the viscid spirals of which I spoke a moment ago.

"In spinning this series, the foundation spirals are used precisely as a scaffolding is used for erecting a house. I will not explain the process at length, as I

fear these details are already tiresome to some of you, but will only say that the spider moves along the radii and the dry foundation spirals at right angles to them, dragging after her the viscid line, pulling it taut when she comes opposite the point from which she started, very much in the method observed when she makes the radii. Curiously enough, as she completes the spirals, she bites away the foundation spiral behind, just as I have seen builders remove the top timbers of a scaffolding as soon as the upper parts of a wall are sufficiently advanced toward completion.

"Tell me," said Abby, "a little more about these beads. What are they made of?"

"They are secreted by the spider from glands that lay along with the silk glands in the lower part of the body near the spinning mammals. I have never been able to separate these glands from those that hold the liquid silk, and they are forced out by the spider through the spinning-tubes precisely as is the material which forms the web work. They probably have special tubes through which they are secreted. I do not know the composition of the beads; but 'Stickwell & Co.' never made anything more viscid. I have kept beaded webs in good condition several months. The material looks like gum, but darkens a little with age. It reflects light, and I suspect that, along with the open meshes of the net-like snare, they in this way help to deceive insects approaching on wing with the impression that no obstacle lies in their course."

"How can the spider make so many beads?"

asked the Mistress. "There must be an immense number of them! How large are they?"

"To begin with your first question, the beads are very small. Let me draw a few strings for you. Here are four sections (Fig. 75, I, II, III, IV) that will give you some idea of their relative size and appearance. For the actual size we must use a pocket-lens or a microscope; but, perhaps, I can show it thus: This last line (iv, Fig. 75) I will represent here (*a*, Fig. 75) in natural length. The divisions on the line iv, marked by little points, correspond with those on the line *a*."

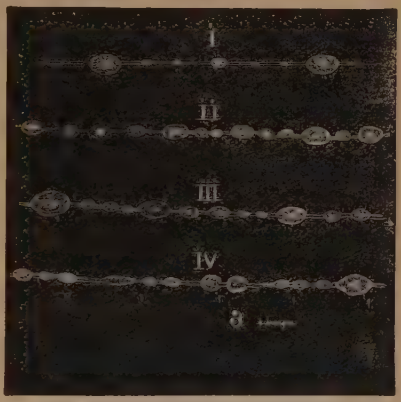


FIG. 75.—ARACHNE'S PEARLS—VISCID BEADS.

"And all those beads are crowded inside that little line?"

"Yes; but what they lack in size they make up in number. I once numbered the beads on a web of ordinary size by actually counting those upon a given section, and multiplying the result by the number of sections. I estimated that there were over 140,000, and in some snares the number must be much larger. It

used to be cited as an example of the wonderful industry and skill of the spider that she could manufacture so vast a quantity of these objects in so short a time. In point of fact, however, I believe that the beads form themselves in a very ordinary way. As they issue from the tubes they gather naturally into minute drops; the effect, perhaps, being aided by the twisting of the threads in the quick-moving fingers of the spinster. However that may be they are truly Arachne's pearls, even though like some of those worn by her sisters of the human species (if rumor speak not falsely) they are only made of paste. But I have exhausted my subject, even if I have not my class, and will say good night to our cunning little builder and her work."

"Was it a geometric spider?" asked Abby, "whose perseverance, according to the tradition, had such an influence upon the Scottish monarch Bruce? The story recently occurred in a reading-lesson of one of my classes, and I wondered at the time what kind of spider had the honor to teach royalty such a royal lesson."

"I cannot promise to answer your question accurately; but, at all events, let us hear the story. It is long since I heard it, and we all will be interested in the telling."

"The narrative runs somewhat in this wise: While wandering on the wild hills of Carrick, in order to escape the emissaries of Edward, Robert Bruce on one occasion passed the night under the shelter of a poor,

FIG. 76.—PRECEPTOR TO HIS MAJESTY: ROBERT BRUCE AND THE SPIDER.

deserted cottage. He threw himself upon a heap of straw, and lay upon his back, with his hands placed under his head, unable to sleep. His gaze was fixed upward among the rafters of the hut, which were festooned with cobwebs. His mind brooded upon the hopelessness of the patriotic enterprise in which he was engaged, and the misfortunes that already had befallen him. From this train of thought he was diverted by the efforts of a spider, who had begun to ply its vocation with the first gray light of morning. The object of the animal was to swing itself by its thread from one rafter to another, but in the attempt it frequently failed, each time vibrating back to the point whence it had started. Twelve times did the little creature try to reach the desired spot, and as many times was unsuccessful. Not disheartened by its failure, it made the attempt once more, and lo! the rafter was gained!

"'The thirteenth time!' cried Bruce, springing to his feet. 'I accept it as a lesson not to despond under difficulties, and shall once more venture my life for the independence of my country.' He renewed the struggle, and this time won success."

The narrative greatly interested our circle, and had warm commendation.

"Now comes the question," I said, "whether Bruce's spider was an orb-weaver? Miss Abby's version differs from that which I remember, which made the spider's effort one to raise a heavy insect of some sort to the roof. Such an incident is more natural, and

the details seem better to correspond with one of our common species of line-weavers. I have never seen any sort of spider trying to reach distant points by oscillating threads, but have often observed them swaying in the wind. But the lesson is worth heeding, by whatever species taught, and even though it be a fable, which is not unlikely, our race has a decided tendency to associate its heroes with such incidents. The story of Bruce and the spider, for example, has its counterpart in that of Timon and the ant.

"This tendency is well illustrated by another series of incidents in which an orb-weaver is, without doubt, the spider referred to. A friend of mine once told me that one of his ancestors, during the massacre of Wyoming, had been saved from death in this way: He fled before the savages, and was pursued closely by a warrior, whom he succeeded at last in eluding, and took refuge in a hollow tree. He had scarcely entered ere a spider began to spin a web across the opening, and wrought so vigorously that in a short time she had woven a beautiful round snare that completely covered the hole into which the fugitive had crept. The web had just been completed, and the spider settled in the center, on the watch for prey, when the pursuing Indian appeared. He peered under and into every place that could possibly afford shelter to a man, and, at last, came to the hollow tree. He glanced at the unbroken web and the spider quietly seated upon it, concluded that no one could have crept into that spot, and hurried on. My friend gave name, date, species and location of

FIG. 77.—"NOBODY IN, SIR. PASS ON!—*p.* 221.

tree, all with accuracy of detail, and declared that the tradition had been handed down with such positiveness as to render it absolutely certain.

"I questioned the story on the ground that it had been told of so many persons, at various periods, that it had become apocryphal. He promised to follow up the tradition and give me the full proofs, but unfortunately died shortly after, before his purpose had been fulfilled."

"I have read a like incident as occurring to some of the martyrs or persecuted saints," said the Mistress. "Who was it—do you remember?"

"The story is told of some persecuted Protestant leader during Reformation times, whose refuge was an oven.

"Saint Felix of Nola had a similar adventure, as recorded in the 'Lives of the Saints.' Being hotly pursued by his enemies, he crept through a hole in an old ruined wall, which was instantly closed up by the spinning-work of spiders. His pursuers, never imagining that anything could have lately passed where they saw so compact a spider's web, after a fruitless search elsewhere returned in the evening without their prey. Felix found among the ruins between two houses an old well half dry, in which he hid himself for six months, during which time he was cared for by a devout Christian woman.

"Long before that Mohammed had the same experience when fleeing from the Koreishites with Abubeker. The two men, says the tradition, hid themselves for three days in a cave, over the mouth of which a spider spread its web and a pigeon laid two eggs there, the sight of which prevented the pursuers from searching within, and thus the prophet and his friend were preserved.

"But the earliest incident of this sort which I recall is told of David, the King of Israel. The Jews have a tradition that when he was fleeing before Saul he took refuge within one of the spacious limestone caverns found in southern Palestine. The friendly spider thereupon appeared precisely as in the other cases; the pursuers passed on, and the fugitive escaped."

"Do you believe that any of these incidents really occurred?" asked Abby.

"There may have been in some one case a basis of fact for the tradition. It is certainly not improbable. But for the most part I count the stories mere fictions, or perhaps fables, intended to teach a lesson of respect for the most despised creatures of God; or perhaps to illustrate the Divine Providence. Be that as it may, it would hardly do for fugitives in our day to rely upon any such interposition, for men have now learned pretty well how rapidly a spider can spin her snare, and he would be a dull fellow who could be balked of his victim by a mistake on this point."

"Wal now, Mars' Mayfiel'," remarked Dan, "I doan tink so porcley uv de spiders as uv mos' oder insec's. De fac' is, dey's mighty peert critters, and dey eats up de bugs powerful. Dey doan do no harm at all, dat I eber seed, 'ceptin' a bite wunst in a w'ile. Some folk 's awful feard to have one git on 'em; but I often heerd in ole Marylan' dat you mustn't nebber kill a spider dat lights on your close; kaze ef yo' do yo' destroys de presents dey's a-weavin' fur you. But I'm not so shore 'bout dat; I've had a heap o' spiders light on me, and de presents es a-been skeerce as duck teeth fur all dat. Mebbe it'll be all right' dough nex' Christmas. De luck mus' change some time, I reckon."

The old fellow bent himself over upon his folded arms, rolled his white eyes in a knowing and comical way toward the Mistress, rocked his body to and fro, and broke into one of his soft, unctuous laughs.

"What Dan means," said Sarah, taking up the conversation, "is them little bits of spiders—baby spiders, I 'spose they are. 'T any rate they're wee things that drop on you from the ceiling or trees by long threads. I've heerd 'em called *money-spinners*, and they say they'll bring good luck if you don't kill or hurt 'em, or brush 'em off when they're first seen. If you do take 'em off your clothes you must throw 'em over the left shoulder, an' that saves the luck. I wouldn't kill one of them monney-spinners on no account; but law sakes alive! that's nothin' to do with the big spiders that spin cobwebs in the corners! There's no good luck in *them;* an nobody but a sloven 'ud let 'em stay around. I sweep 'em out without marcy."

"But, Sairy Ann," said Dan, "you neber oughter kill a spider inside de house. Ef you mus' do't, w'y do't out'v doors. Et's jes' pullin' down your own house to kill a spider indoors."

"The notion about the money spinners," I remarked, "is, or was, quite prevalent in England and Scotland, and I have often heard it here in America. I never quarrel with it, for it goes some length toward preserving the best of our animal friends from senseless hatred and destruction. I recall another use of the superstition made by a quaint old divine: 'When a spider is found upon your clothes,' he says, 'we used to say some money is coming toward us. The moral is this: Such who imitate the industry of that contemptible creature may, by God's blessing, weave themselves into wealth and procure a plentiful estate.'"

"The most curious thing to me about spiders," remarked Hugh, "is w'ere they come from; I've known a house to be cleaned thorough from top to bottom, and almost in a night a new crop sprung up. You w'itewash a fence or a wall till there's not a cobweb to be seen, and it's no time afore they're spun up ag'in, bad as ever. I've hear'n that spiders breed from some kind of seeds that putrefy in the air, or spring up spontaneous from any sort of corruption. It does look somethin' like it, but w'at puzzles me is that they breed so rapid on places that have jest been swept an' purified."

"There, Hugh," I answered, "you have touched upon a very old conceit. It was a favorite theory among ancient writers that spiders, and, indeed, many other creatures, were generated spontaneously from decaying objects. That arose quite naturally from seeing such matter usually covered with insects. The rapidity with which multitudes swarm to decomposing substances must have appeared wonderful, as it still appears to people who had no knowledge of the hordes who lurk in trees, bush and weeds, and burrow in every inch of soil. They are natural scavengers, and the presence of corrupt material attracts them immediately in immense numbers to the work for which they are fitted.

"Some devour the substance, some remove it, some bury it, many at once deposit in it eggs, or even bring forth worms which fill it with living creatures in an incredibly short space of time. The ancients, igno-

rant of these facts, believed that such animals had been spontaneously generated."

"But, father," said the Mistress, "all this doesn't quite cover the point that Hugh has raised about the spiders. That does seem strange; although, of course, I know that they are bred from the eggs, and don't spring out of dust and decay."

"I will come to that," I answered; "and I can best illustrate it by an incident that occurred last summer. I spent a week with a party of friends fishing upon the St. Lawrence River. Our fishing ground lay between Alexandria Bay and Lake Ontario, a region which in summer time abounds with spiders, who are nested along the shores and among the trees that cover the beautiful Thousand Islands. The skipper of our steam yacht, who soon discovered my entomological hobby, related an experience very much like Hugh's.

"'I can't imagine where all the spiders come from,' he said. 'Every morning I find their round webs spun all over the boat in amazing quantities. I have them cleaned out carefully, and the next day there they are as thick as ever! They keep it up that way all summer, and the spiders are just as thick at the end of the season as the beginning. Where do they come from? How do they get aboard the boat? I never found anybody who knew, and if you'll solve the mystery I'll be obliged.'

"Fortunately, I was able to give a satisfactory explanation. It chanced that on my way to Alexandria Bay I took the evening passenger boat that plies between

that point and the railroad terminus. The shadows began to lengthen as I sat in the stern of the steamer watching the charming panorama of green shore, rocky islands, and lovely villas unfold while we steamed through the transparent stream.

"Suddenly a dark object passed between me and the scene. It was a huge Furrow spider (*Epeira strix*), laying out the foundation lines of her snare. She had dropped from the cornice of the upper deck to the bulwark, and was mounting again when I caught sight of her. Another and another followed, and before we landed several webs were spun against the roof. I peeped under the railing against which my seat was placed, and found a number more cozily ensconced within their tough silken tubes awaiting the nightfall to begin operations.

"Our skipper's yacht I soon found to be occupied by a colony of the same species, and I solved his mystery by calling attention to the fact.

"These spiders, at various times, have come aboard on little silken balloons, which, as they were borne across the river, struck upon your boat. The tiny aeronauts dismounted, and took up their quarters. They rarely appear in daytime, but at night, after you have landed and gone home, they creep out, spin their webs, and feed upon night-flying insects. In the morning, before you are ready to sail again, they are back to their dens and tents in crannies under the mouldings. Your men brush down their webs—that's all! The spiders weave them next morning, quite un-

concerned, and so the year wears on. They even breed on your yacht, I find, and have probably been succeeded by their offspring in this 'life on the ocean wave.'"

"'Well, well,' said the skipper, 'that's a kind of stowaway I never heard of before. I shall know now how to make a clean sweep of them hereafter; but, really, I don't know that I shall do so, for such cute little beggars are almost entitled to a free passage.'

"'True enough,' I replied, 'and, moreover, they quite earn their way by ridding the vessel of more objectionable entomological passengers, who are popularly supposed to have free lodgings on water craft!'

"'Oh! as to that,' was the quick response, 'we don't have any such shipmates aboard *this* boat!'"

CHAPTER XIII.

A BATTLE, A CONQUEST AND A NIGHT-RAID.—THE CUTTING-ANT OF TEXAS.

THE morning following our last conversation was one of rare excitement at the old farm. One of our most esteemed household pets is Dolf, the dog. He is a cross between a bulldog and a shepherd, is an admirable watchdog, a devoted friend and follower of his master, and has conceived a warm attachment for the Schoolma'am. As to the rest of the household, and visitors generally, he is kind enough, or rather harmless by reason of supreme indifference. However, he has an inextinguishable jealousy of those of his own kind who may enter upon what he considers his lawful domain.

I was, therefore, not so much surprised as agitated to hear issuing from the front porch that peculiar combination of sounds—snarling, snapping, yelping, tearing, scratching, wrestling—which accompanies a dog-fight. I was engaged at the time in the back yard, with Penn Townes, a thrifty young farmer and descendant of Jane Townes, the pioneer, who had ridden over from his neighboring place on some matter of business. Unfortunately his dog had accompanied him, a fact which I had not observed until the clamor on the front porch announced it. I rushed to the scene of

battle, picking up a croquet mallet as I ran. Young Townes followed, armed with his riding-whip. The discords of the fight grew fiercer, and then for a moment ceased at the sound of a woman's voice, heard above the din in sharp command.

My heart leaped to my throat. What woman could be so hardy as to interfere in such a conflict? We turned the corner of the house, and saw Abby Bradford standing between the two dogs. She had grasped them by the leather collars around their necks, and held them aloof by main strength. The animals stood at full height upon their hind-legs, and struck at and struggled to reach each other with their forepaws and fangs. They were face to face, with glaring eyes and foaming mouths, while horrible growls issued from between their white teeth.

It was a splendid sight: the maiden's erect form, whose every muscle was swollen by the effort to hold the fierce beasts at bay, crowned by the pale face, set with the intensity of emotions, under whose play every feature was illumined with new beauty. It is strange how a human face lights up and transforms under the agitations of a high and courageous deed! I have never seen a sharper and more significant contrast between the moral faculties as represented by man, and the animal passions characteristic of the brutes, than that exhibited by the tableau which came into view that morning as we entered the front yard—those rampant and angry dogs struggling in the hands of that brave, comely young woman!

This thought was involuntary and instantaneous. It was as fully rounded before my mind in that moment, while running in full heat, as now, while I quietly write under the shadow of my tent-studio beneath green trees. But there was no delay in action; indeed there was need of haste, for the large animals, doubly strengthened by their anger, had well-nigh exhausted Abby's strength, and were once more striking each other with their fangs. She relinquished her hold, and between whip and mallet the young farmer and I parted the dogs at last, and Dolf was sent growling to his kennel. Then we turned to Abby, who, meanwhile, had stood intermingling with the angry shouts of the men and the yelps of the dogs, earnest pleas that the poor brutes should not be injured.

"Are you hurt?" I asked.

"Why, no! That is, I think not. Really, I hadn't thought of that. But I am not sure."

She lifted her hand; it was covered with blood from a cruel wound in the thumb.

"Ah, I remember now. It was Dolf who bit me; but he didn't mean it, poor fellow! He loves me too well for that. I don't think I am much hurt."

"Not hurt, honey?" cried old Dan, who had just arrived panting and excited. "Not hurt?" throwing up his hands and showing the whites of his eyes; "look at dat blood den! Drat dat ole dorg! He'd orter be massacreed, chawin' on sich a lily han' as dat! Hol' on dar a minit; I'll fix dat bleedin'."

He ran to the arbor vitæ hedge, where numbers of

the specked Tubeweaver (*Agalena nævia*) yearly spin their broad snares, and scooped up several of the sheeted webs.

"Hole up dat han' now, honey; cobwebs is famous for stoppin' blood. Dis'll do it shore! Doan you worry now. Ole Dan'll make it all right. Dar now, dat'll do."

As he cooed on in this way he applied the web like a plaster to the torn flesh. His rough surgery was happily successful in stanching the blood.

By this time the whole family had assembled, Abby herself being far the least agitated of the group. Such home remedies as were available were applied to the wound, and Joe was posted off for the doctor. The household was unanimous in upbraiding the bold girl for her act, and just as unanimous in admiration of her courage.

No one was more enthusiastic in praise than Penn Townes. "It was the pluckiest thing I ever saw," he averred, "whether done by man or woman." He was sincere in regrets and apologies for his own share in the misfortune by allowing his dog to follow him, and rode home evidently much disturbed.

This is how our Schoolma'am and Farmer Townes became acquainted, and it thus happened that two new members were introduced to our family conversations.

On the evening of the accident Penn called to inquire about Miss Abby, who, being quite able to answer for herself, did so, evidently much to the young man's satisfaction. A few days thereafter he called again, and,

as the next evening was our time for Weekly Conversation, he expressed a lively interest in the matter, and begged permission to attend. Of course we readily consented, although the Mistress somewhat abated my zeal over the acquisition of a new proselyte to entomology by suggesting that, perhaps, the chief object of Penn's interest belonged to a higher order of creatures than insects! But that is a way which our lady friends have—they seem to think that no subject can have such attractions to men, particularly young men, as themselves! Be that as it may, Penn appeared in our next circle, and as the invitation had been extended to all his family, he brought with him his mother.

Mrs. Townes is a plain Friend, adhering closely, but without rigidity, to the doctrines, manner, dress and speech of her ancestors. She had already shown a neighborly interest in us, and with a love of nature and natural science which is characteristic of the Society to which she belongs, entered heartily into our conversations. Her kindly ways had gained for her among "world's people" throughout all our country side the familiar title of "Aunt Hannah." We readily dropped into the usage, as it seemed a happy compromise between the plain "Hannah" of her co-religionists, which appeared to us lacking in respect, and the formal "Mrs. Townes," which was somewhat distasteful to her.

"Among the tenants of our old farm," I said, "there are none more numerous than the ants. I shall have something to say about them by-and-by, but to-night I shall speak about some of their cousins-german who

live in Texas. One summer I visited that State to make some studies upon a certain ant."

"Does thee mean to say," interrupted Aunt Hannah, "that thee went all that distance, two thousand miles, just to study a single insect?"

"Certainly he did," the Mistress answered, "in the blazing heat of summer, too. He lived like an Indian, worked like a negro, spent no one knows how much money for traveling, outfit, wages, etc., then fell to work and wrote and published his book at his own expense, all for the sake of one miserable little ant that stings like a wasp, and is a nuisance in Texas harvest fields. You wouldn't ask such a question, Aunt Hannah, if you knew the naturalists better. Why, they are the veriest race of Paul Prys I ever saw. Talk about the curiosity of women! I don't believe there's a woman in Christendom that would go through so much labor, danger and expense just to peek and pry into the secrets of an ant-hill. But, there! Excuse me, dear. I fear this is an outbreak of the old-fashioned prejudice. You know I am now only too happy to see you busy among your bugs."

The company had a hearty laugh at the Mistress's somewhat vivid portraiture of a naturalist, in which I joined with zest.

"I shall not be offended," I said, "at such good-natured truth-telling as that. I assure you that I think none the less of myself for that old-time infatuation. Moreover, I cordially agree with the conclusion of the matter. Men are more curious than women

many times over. I have often said it, and for that very reason have maintained that the sterner sex will always be the superior naturalists. But a truce with this! We are making no progress with our story.

"I made my camp in a mesquit grove on the plateau of Barton Creek, a branch of the Colorado, a few miles beyond Austin, not far from the government trail to San Antonio. Here I found the insects which I sought in abundance, and spent several weeks studying them. But I shall not speak of them now. I found also another interesting species, the Cutting or Parasol Ant, whose habits I investigated. They furnish a remarkable example in one insect of both the cave-dwelling and engineering habit of which we have been recently conversing. In the first place we want to make the acquaintance of the ant itself. In this box, which I have had sent me from my collection in the Academy of Natural Sciences, are pinned specimens of the various castes or forms that may be found in one of the Cutting-Ant nests.

"Is it possible that these are ants?" cried Abby, as the box was opened. "Why they are larger than a bumble-bee."

"Yes, these largest forms are the females or young queens, the next in size are the males. These wingless fellows with the large heads are the soldiers, and others, running down through several forms to these tiny creatures no bigger than our little brown garden ant, are the workers. This difference in size among the individual castes of one species, in one common domi-

FIG. 78.—WINGED FEMALE, MALE, SOLDIER AND WORKER-MAJOR OF CUTTING-ANT (*Atta fervens*).

cile, is one of the most curious facts in natural history."

"A word about these winged ants?" asked Abby. "I do not quite understand. I have often heard people speak of a winged ant as though it were a special kind. But you speak of winged and unwinged forms in the one nest. Please explain."

"The males and young females of ants are always winged. In this respect they resemble their hymenopterous allies, the bees and wasps. When they are

matured, they swarm or go forth on their marriage flight, as it is called. After this, the males all perish or are devoured by various animals. The young females tear off their wings and burrow in the ground. They are then queens, and become mothers and founders of new colonies."

"But why do they tear off their wings?" asked Abby. "The queen bumble-bee that we saw the other day had her wings quite like all the other bees."

"Yes, the workers of bees and wasps are all winged, and their mode of life, while gathering food afield as well as at home, for the most part requires and is accommodated to a winged state. It is different with ants, who are largely scavengers and burrowers, having no use for wings except during the marriage flight, for which purpose solely they seem to be provided. The queen ant doubtless finds the beautiful appendages to her wardrobe entirely too cumbersome for her workaday life, and therefore puts herself into plain attire."

"There, Aunt Hannah," suggested Abby. "You see you can 'go to the ant' to find a justification for your notions about plain dressing."

"Thank thee, Abby, for thy good word," said Aunt Hannah, smiling. "But thee forgets that the queen bee and all her busy workers, who have quite as good a name for the virtues of industry and economy, keep their gay apparel. Friends are not so severe in their views of dress as they used to be, and perhaps there is less need of their testimony. At all events, to return to thy analogy, if it seems becoming to the queen ant to

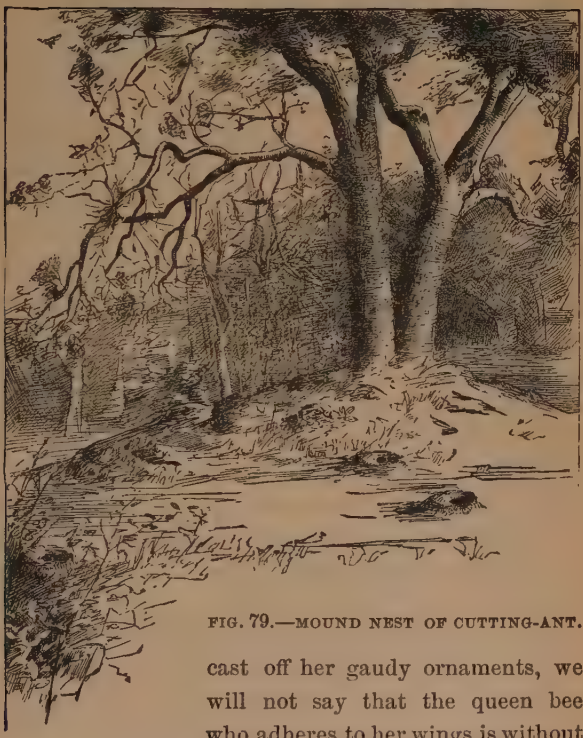


FIG. 79.—MOUND NEST OF CUTTING-ANT.

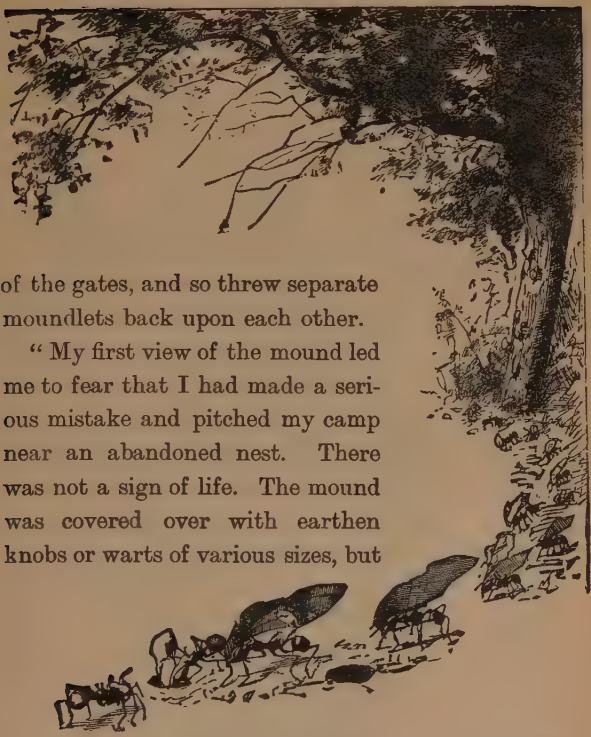
cast off her gaudy ornaments, we will not say that the queen bee who adheres to her wings is without natural, becoming and industrious ways. My plain bonnet suits me very well, Abby, but perhaps it might not be so becoming to thy beauty. Though, I think thee would make a very pretty Quakeress, too!" she added, with a pleasant smile, and kindly glanced at the blushing Schoolma'am.

We cordially enjoyed this good-humored sally, and

with a word of commendation for Aunt Hannah's generous opinions, I resumed my narrative.

"There were several large colonies of cutting-ants at points sufficiently near camp for purposes of study. The surface architecture presented two typical forms. One of these was that of a mound twenty-one feet long and about four feet high, which had been accumulated around a large double-trunk live-oak tree (*Quercus virens*), which stood on the side of a road. (Fig. 79.) The second form was located on a high, flat, upland prairie, and was a bed of denuded earth, about nine by seven feet in dimensions. It was placed in the midst of the grassy open, but not far from a young grove of forest trees.

"Over the denuded surface were scattered between twenty and thirty circular, semi-circular, and S-shaped elevations of fresh earth-pellets. The circular moundlets had the appearance of a cuspidore, the resemblance being stronger by reason of a round, open entrance or gallery-door in the center. All had been naturally formed by the gradual accumulation of the pellets of sandy soil, as they were brought out by the workers and dumped upon the circumference of the heap. The moundlets were from three to four inches high, massed at the base, and gradually sloped off toward the top. I found several of these 'beds,' as the Texans call them, and this is doubtless the normal form of the external architecture of the formicary. The live-oak mound was probably formed by accumulations around the tree, caused by the bordering road which restricted the limits



of the gates, and so threw separate moundlets back upon each other.

"My first view of the mound led me to fear that I had made a serious mistake and pitched my camp near an abandoned nest. There was not a sign of life. The mound was covered over with earthen knobs or warts of various sizes, but

FIG. 80.—PROCESSION OF PARASOL OR CUTTING-ANTS.

the action of a recent shower upon the black soil gave the hill the appearance of an old one. Here and there were scattered over the surface small, irregular heaps of dry leaves, bits of leaves and twigs. Otherwise the mound seemed lifeless, deserted.

"My next visit was in the evening. After supper I

FIG. 81.—THE PARASOL ANT—AN EMMET ROBINSON CRUSOE.

left one of my men to guard camp and build a camp-fire, and took another with me carrying a lantern, to the live-oak nest. An amazing change had occurred; instead of silence and seeming desolation a scene of thronging life and stirring activity was presented. Hosts of ants of various sizes, and in countless numbers, were hurrying out of open gates into the neighboring jungle, and two long double columns were stretched from bottom to top of the overhanging live-oak; one column ascended, the other descended the tree. The ants in the descending column all carried above their heads portions of green leaves, which waved to and fro and glanced in the lantern light, giving to the moving host a weird look as it moved along. It seemed like a procession of Lilliputian Sabbath-school children bearing aloft their banners. It is this habit which has given the insect in some quarters the popular name of the "Parasol Ant."

"But what could the creatures want with parasols?" asked Abby. "There was neither sunshine nor rain to protect themselves from?"

"We shall see the use of these leaf-cuttings presently. The name parasol is of course based upon a popular fancy, as these ants when seen abroad are usually accompanied—like that friend of our boyhood, Robinson Crusoe—with their odd-looking umbrella-like appendages." (Fig. 81.)

"Do they hold them in their hands?" asked Aunt Hannah.

"No, in their jaws or mandibles; an odd place to

carry a parasol, perhaps, but they manage it well. I will show you how this is done when I have explained the leaf-cutting habit. I observed very fully at the nests around my camp and in vegetable gardens near Austin the mode of cutting and carrying leaves. In order better to see the process I thrust leafy branches of live-oak into the mound near the gates. They were soon covered with ants, and as the lantern could thus be used conveniently, the operations of the cutters were completely in view. The cutting is done in this way: The cutter grasps the leaf with outspread feet and makes an incision at the edge by a scissors-like motion of her sickle-shaped, toothed mandibles. She gradually revolves, steadily cutting as she does so, her mandibles thus describing a circle, or the greater portion thereof. The feet turn with the head. The cut is a clean one quite through the leaf."

FIG. 82.—DEFOLIATED TWIG OF PRIDE-OF-CHINA-TREE.

"How large a piece do the insects cut out?" Aunt Hannah asked.

"The cutting is about the size of a ten-cent piece or sixpence, and is usually roundish in shape, though often irregular. The cutter would sometimes drop with the

FIG. 83.—ANT MAKING A CUTTING FROM A LIVE-OAK LEAF.

excision to the the ground, sometimes retire when the section had dropped, and sometimes seize the section and carry it down the tree or branch."

"I was greatly interested to notice here an apparent division of labor. At the foot of one tree was a pile of cut leaves, to which clippings were being continually added by droppings from above. Carriers on the

FIG. 84.—HEAD OF A CUTTING-ANT, ENLARGED EIGHT TIMES.

ground took these up and bore them to the nest. The loading of the sections was accomplished in this wise: the piece was seized with the curved mandibles, the head elevated and the piece thrown back with a quick motion. Let me draw for you the head of an ant and you will see how this is done. A deep furrow runs along the entire medial line, except the part at the very end of the face called the clypeus. At the edge of this furrow, on either side, and on the prothorax projecting over the neck are prominent spines, which you will notice if you look again at the specimens. (Fig. 84.)

"I have a cousin who once lived in Texas," remarked Penn, "and he has told me that things down there have a wonderful tendency to be jagged and thorny. How is that?"

"Certainly it is so with many plants and animals. Both species of ants studied by me, the cutting (*Atta fervens*) and agricultural (*Pogonomyrmex barbatus*) are marked with strong spines. Then there are spinous spiders, though we have some of them on our old farm too; horned toads hopping everywhere, horned lizards running swiftly over the ground, prickly cactus plants grown into great bushes, thorn trees of many sorts, the soap plant, the splendid Spanish bayonet, certainly well named, and, not to be tedious, the famous wide-horned Texas cattle herding in thousands on the plains.

"The spines upon our cutting ant together with the furrow seem to serve a very good purpose. The worker seizes the leaf-section and by a quick motion lodges it on edge within the furrow and between the

spines. This is done, at least, in some cases. The cutting and carrying were not done, so far as I saw, by the smallest castes. The soldiers also rarely engaged in this work but were seen to precede the excursion columns as they moved out and up the tree, and afterward to return as though engaged as scouts or pioneers. They are grotesque-looking creatures as they move along with a rolling gait, shaking their big heads and waving their antennæ.

Here Dan joined in the conversation.

"Mars Mayfiel', I doan see how you could abar to mix up wid dem ants in dat away. I wouldn't do it for no money. Dey's entirely *too* wise for sech brute critters. Tain't naterl wisdom nohow. How yo' s'pose dey do all dem tings jes by 'msels? Doan tell me! My ole mammy done tell me often: 'Nebber 'stroy de ants, honey. Dey'z all fairies; eb'ry one of 'em fairies; 'n ef yo' interfar wid' em dey 'll 'witch our cows so dat dey'll give no milk.' Dis's a great dairy county, Mars Mayfiel', 'n I tell yo' dar's powerful need of bein' cautious 'bout meddlin' too much wid tings wat's got sech onnaterl ways. 'Scuse me, sah, but dat's *my* 'pinion."

"All right, Dan," I responded; "this is 'Liberty Hall' on our Conversation nights, and we want every one to feel free to speak upon the subject before us. Besides, I have now said all that I intend to-night, and will gladly hear others."

"Daniel," said Aunt Hannah, "doesn't thee know that that is superstition? No such power as thee

spoke of is given to any creature. The insects have natural power to harm us, and they do it pretty freely, some of them, but they have nothing more, and thee is too old to believe and utter such unwise things. Where did thee learn such things ?"

"I am afraid, Aunt Hannah," said I, answering for Dan, "that our friend is too old to rid himself of these notions, and I have already put our young people on their guard. I don't wonder, however, that Dan has picked up that superstition about ants bewitching cows, for he is from Maryland, you know, and such an opinion does certainly prevail in the neighborhood of Washington, and throughout Virginia."

This little episode concerning the occult powers of nature brought Sarah to the front, as such subjects were pretty sure to do. Standing in the kitchen door with hands under her apron, she attacked Aunt Hannah's position with much emphasis. "Superstition! There it goes ag'in! Folks is got so awful larned nowadays, that they're not content onless they're upsettin' some belief 'r other that common folks hold, an' their feythers afore 'em. Now, for my part, I *believe* 'n witches. More 'n that, I believe that not only dumb critters but human bein's, too, are bewitched —lots of 'em! That's not to say, however, that Dan's right about them ants. I don't believe ther's any harm in 'em at all. Dan got the cart afore the horse, as he ginrely does. I believe there's good luck in ants. They're most industrious critters, trig and tidy as a posey. An' w'at's more, Scripter commends 'em, and

FIG. 85.—ANTS BEWITCHING THE COWS.—*p.* 247
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sots 'em up as an example for usn's—barrin' always them pesky little red house-ants w'ich I don't believe Scripter ever meant to include. Doesn't the Bible say 'Go to the ant, thou sluggard—consider her ways and be wise'? Now you don't think the Bible'd speak that-a-way 'v witches, do you, Dan? Of course not.

"I *always* heerd there 'z good luck in ants. My granmam told me—she was an Englishwoman—that it was writ in the Royal Dream Book that to dream of ants or bees showed that you'd live in a great town or city, or in a large family, and that you will be industrious, happy, well married, and have a large family."

"Well, Sary Ann," answered Dan, rising from the cricket and placing himself in a safe position by the back kitchen door, "ole Dan, mebbe, doan' git t'ings allus perpendickler; but I reckon he'd git it 'bout right this time ef he'd 'low that *you* didn't never dream uv ants!" With this retort he disappeared, wafting back to the disconcerted cook—whose matrimonial venture had been notoriously unfortunate—a triumphant and aggravating "He, he! ho!"

"Thee must excuse Daniel," said Aunt Hannah, who felt bound to apologize for the old man's familiar ways. "Thee knows he has been employed in the family for half a century and more, and like most old servants, he is disposed to take many liberties. Indeed, he feels a sort of proprietorship in the old place."

"Don't trouble yourself, Aunt Hannah," responded the Mistress. "Mr. Mayfield is anxious to call out all the curious notions and superstitions which prevail about

insects amorg all classes of persons, and he has encouraged all our people to talk freely. They are not likely to step much beyond the bounds of propriety, and I don't care to restrain them."

"Very well; thee will find Daniel a good, faithful fellow, but much tainted with curious African superstitions, and sometimes over-free with his opinions. Good-night, and many thanks for this pleasant evening and thy kind invitation to return. Come, Penn, if thee has finished explaining that ant-hill to friend Abby, we will go.'

CHAPTER XIV.

A TOUR THROUGH A TEXAS ANT-HILL.

"WHAT do the cutting-ants do with the leaves which they carry into their holes?" The evening's conversation began with this question.

"I was very anxious to answer that inquiry, you may be sure, and there was only one way to do so—I must dig up the nest. My three assistants were armed with pick and shovel; I was provided with trowel, knife, pocket-rule, and my little satchel, filled with boxes, bottles, and various odds and ends for collecting specimens and other work. Camp-stool and drawing materials stood at the road-side. We knew that the insects would swarm upon us in innumerable legions when we assaulted their home, and that their sharp pincers would be formidable weapons. We therefore, like ancient knights, girt ourselves with armor for the conflict.

"Handkerchiefs and scarfs were bound around face and ears under our hats; bandages swathed our necks tightly; trousers were thrust into boot-tops, and these tightened to the legs; hands were gloved and wrists bandaged; indeed, every opening through the clothing by which the angry ants might find way to the body was protected by wrappings. Thus arrayed, I led my little army to the assault.

Two men were detailed for the digging, one to the work of brushing off the ants with leafy branches and wisps of grass. Two trenches were made; one ten feet long and five feet deep, and a second at right angles to it, and wide enough to allow free entrance for purposes of study. We were not disappointed in our calculation as to the reception which the ants would give us. The swift use of the spade and the general convulsion of their emmet world did, indeed, daze them for a little while; but they were not long in rallying. Hundreds—thousands—hundreds of thousands poured out of the excavations. I never saw anything like it. I was amazed at the extraordinary number of creatures inhabiting that one hill. The knight of the whisk was overwhelmed with the duty of keeping the assailing legions from his comrades of the spade. I came to his help. We were both driven to our utmost. The diggers were literally covered with ants; and when the insects had mounted as far as their necks, they were compelled to leap from the trench, and join their own labors with ours in freeing them from the attacking hordes."

"It does seem too bad," exclaimed Aunt Hannah, "that thee should have felt bound so to destroy the poor creatures! Didn't thy conscience hurt thee some for such wholesale spoliation and killing?"

"Not in the least—certainly in the case of cutting-ants, who are fearful pests to the farmers, as we shall see by-and-by. Do you feel any scruples at your husband's slaughter of the potato-beetles?"

254 FIG. 86.—KNIGHTS OF MYRMECOLOGY STORMING THE ANT-HILL.

"Joseph doesn't have any, at all events," said Aunt Hannah, smiling.

"Besides that," I continued, "the naturalist, as a priest in the temple of nature, must have some power over the life of the lower creatures. I didn't kill any more ants than were actually necessary for study. If we hadn't killed them they would have driven us from the field; for I assure you, Aunt Hannah, they don't practice your gentle Quaker principles of non-resistance. But to go back to my story.

"By dint of perseverance we finished our trenches, and had beautifully exposed the interior of the formicary. We were not long in reaching the caves in which the ants dwell. Then came my turn to enter the trench, for the rude strokes of spade and pick could not be trusted to the delicate work of making out the forms and proportions of the rooms and roadways of the formicary. It is no easy task to trace these through the inside of a crumbling ant-hill, and it required careful work. Down into the trench, therefore, I must go, and as I had to work slowly and at close quarters, picking away piece by piece, measuring, taking notes, gathering specimens, I was far more exposed than my assistants. Indeed, it required the united efforts of all three to keep the ants away from my face. As for the rest of my body I bade them let that go, although occasionally a soldier ant would thrust his sharp sickles even through my clothing, and force me to give him attention. However, our punishment by these insects was mild as compared with that of the

FIG. 87.— VIEW OF TRENCH EXPOSING THE INTERIOR OF CUTTING ANT-HILL.

agricultural ants, who have stings as sharp and virulent as hornets.

"The interior of the formicary may be briefly described as an irregular arrangement of caverns communicating with the surface and with each other by tubular galleries. These caverns or pockets were of various sizes, three feet long and less, and twelve inches deep by eight inches high, and less. Now we come to the question of how the ants dispose of the leaves which they collect.

"Within these caverns were masses of a light, delicate leaf-paper wrought into what may properly be called 'combs.' Some of the masses were in a single hemisphere, filling the central parts of the cave; others were arranged in columnar masses two and one-half inches high, placed in contact along the floor. Some of these columns hung-like a rude honey-comb or wasp's nest from roots that interlaced the chamber. The material was in some cases of a gray tint, in others of a lead-brown color and was all evidently composed of the fibre of leaves." (Fig. 88.)

"You speak of this material as leaf-paper,' said Abby. "Do you mean that the leaves were fastened together like pieces of paper, or that they were ground up and made into a true paper?"

"The fibre of the leaves had actually been reduced to pulp, and spread out into a papery mass, which had dried into the shapes described."

"But how could this have been done?"

"Undoubtedly by the joint action of the mandibles

FIG. 88.—CAVE OF THE CUTTING-ANT, SHOWING THE LEAF-COMBS.

and salivary glands. The former organs are powerful instruments that readily grind up the leaves, which are kept moist and pliable by the latter organs. This is, in fact, a rude process of paper-making, and it is not surprising to find the habit in the ants, since it exists in great perfection among their close relations, the wasps.

"On examination, the pulpy masses proved to be composed of cells of various sizes, irregular in shape, but maintaining pretty constantly the hexagon. Some of the cells were half an inch in diameter, many one-fourth inch, most of them one-eighth inch, and quite minute. Some were one inch deep, and usually narrowed into a funnel-like cylinder. Large circular openings penetrated the heart of the columns. Ants in great number, chiefly of the small castes, were found within the cells; in the first large cave opened were also great quantities of larvæ."

"Does thee know what these leaf-combs are used for?" asked Aunt Hannah.

"I believe that they are the living-rooms of the ants, particularly of the grubs and younglings. The eggs, I think, are deposited within the cells, and are there hatched. The paper is so fragile that it breaks under the most delicate handling, but the ants ran over it with impunity. However, Mr. Belt has started the curious theory that the leaf-paper masses are a sort of mushroom garden, wherein a minute fungus is purposely cultivated by the ants for food. That, if true, would certainly show a rare degree of intelligence, though by no means beyond the emmet capacity. I

submitted some of my specimens to the microscope, and they did show fungus growths, but that is only what might be expected in such dark, underground environment. I believe that the chief food of the ants is the juice of the leaves which they gather, although they are not confined to that diet. I saw one immense column, for example, engaged in plundering a granary of wheat, which was being carried away, grain by grain. to the nest."

"Have they any preference among the trees which they defoliate?" asked Abby.

"Yes; a decided preference. The principal leaves gathered at my camp were those of the live-oak. The great tree above the mound was, in some parts, stripped to the very top. The young saplings in the neighborhood were in great part or wholly stripped. Some wild vine unknown to me was an especial favorite, but some plants stood in the little thicket around quite untouched. I thought it curious, by-the-way, that the workers showed a preference for beginning their operations at the topmost or outmost twigs of the branches. A china-tree which I observed showed one side nearly stripped of leaves, while the other side was untouched. (Fig. 89.)

"I visited the grounds of an intelligent nurseryman near Austin, and learned from him many interesting facts. The ants prefer trees with a smooth leaf, are severe upon grapes, peaches, china-tree, radishes; take celery, beets, young corn and wheat, plum, pomegranate, honeysuckle, cape jessamine, cape myrtle, althea.

FIG. 89.—PRIDE-OF-CHINA TREE STRIPPED OF LEAVES ON ONE SIDE BY CUTTING-ANT.

On the other hand, they do not like lettuce, won't take the paper mulberry, nor figs and cedar, except the bud ends in the scant days of winter. They love sugar, grain and—tobacco!"

"Tobacco!" exclaimed Aunt Hannah; "can such an unnatural taste exist in a pure state of nature?"

"Oh, for that matter," remarked Abby, "I think

it far more fitting material for an ant's jaws than a man's !"

"They certainly seem to find a use for it," I resumed, "for the nursery man assured me that the ants made foraging excursions even into his house, entered his desk-drawers, and carried away a portion of his chewing tobacco before the robbery was discovered. He had to be very careful thereafter where he deposited the delectable weed."

"Truly," cried Abby, "wonders never cease to be explained. It has always been a mystery to me how the tobacco-chewing habit could have originated among men. But here we have it ! It comes down by long descent from some far away emmet ancestor of ours !"

"Tut, tut, Abby," interposed Aunt Hannah. "What does thee mean by such nonsense ?"

"Nonsense ! Why should you call it that ?" retorted Abby, while her eyes twinkled merrily. "It was only a few days ago that I read, floating through our daily papers, a saying of one of Mr. Mayfield's distinguished ant-loving friends to the effect that if one were to judge from intelligence and general affinity of social habit and organization alone, man might more readily be derived from an ant than from an ape. So, there ! My remark has the wisdom of the evolutionists behind it, and a specialist's justification besides."

"We cannot stop to settle the wisdom of Abby's remark," I observed, "or even whether she is in jest or earnest. But I will cordially endorse Sir John Lubbock's remark, with a good deal of emphasis, however,

on the *if*. I was frequently surprised at the ability of these cutting-ant masons to excavate vast halls and subterranean avenues. I visited several holes in the vicinity of Austin, out of which 'beds' or nests of ants had been dug by an old man who used to follow the business of an ant-exterminator. These holes were nearly as large as the cellar of a small house. One such excavation, about three miles from the city, was twelve feet in diameter and fifteen feet deep. At the lowest point the main cave or chamber had been found which, I was told, was as large as a flour barrel. In this central cavern were many winged insects, males and females, and quantities of larvæ. It was the head-quarters of the formicary, whence, in various directions, radiated avenues through which the workers issued upon their numerous raids.

"I was struck by the engineering skill displayed in laying out these avenues. Take this example. The nest of which I speak was situated 669 feet from a tree that stood in the front yard of a gentleman's house. The tree had been stripped bare of leaves by the cutting-ants! Assisted by a young civil engineer, I took the range of the underground way traversed to reach this point, and from the survey, an accurate route was constructed by a friend in the office of the Pennsylvania Railroad. This is a copy of it (see page 264.) You see that the course varies little from a direct line. There were no turnings or twistings, but the tunnel ran from point to point straight as an arrow flies. In this respect the map is true to the facts." (Fig. 90.)

FIG. 90.—AN UNDERGROUND ROUTE OF CUTTING-ANTS.

"That is an important explanation," Abby remarked, "for I have learned to take all maps that issue from railroad offices with great allowance for a scientific use of the imagination. It is surprising to see how straight their lines run between main points *on the maps*, and how many curves, sweeps and deflections there are when you come to ride on their trains!"

As Abby's sally evidently touched a common experience it was greeted with hearty merriment. "I can vouch for the accuracy of this chart, at all events," I said. "And this is all the more remarkable when you remember that the lines were run *underground*. In some places the tunnel was as deep as six feet beneath the surface, the average depth being about eighteen inches. At the 'Exit Hole,' 484 feet from the nest, the tunnel was two feet deep. I am not prepared to say upon what principles these lines were laid out by the ants, but I venture the opinion that they show as good evidence of thorough engineering in going directly to their points of des-

tination, as do the famous underground railways of London. Besides this main way which I have described, there were two branch tunnels which deflected from the trunk-line near the country road, in order to gain entrance to a peach orchard one hundred and twenty feet distant."

"How did you trace these tunnels?" asked Penn. "It must have been an immense work to dig after them."

"The work had been done by the planter, who, determined to exterminate the nest, had traced it up with the help of laborers. Much of the way was actually dug out, and the trench was visible when I visited the place. As to the rest, it was only necessary to sink holes here and there along the estimated course, and when the tunnel was struck, take another bearing. The nest was finally reached, and the great pit was there to show how extensive the colony had been.

"In view of such observations as these, I am quite prepared to believe the story related by Dr. Lincecum, who long observed the habits of the cutting-ants in Texas, that they on one occasion *tunneled beneath a stream* in order to reach a garden that lay on the opposite side. There is one other remarkable habit which I observed before the mound nest near my camp had been destroyed. It relates to the opening and shutting of the gates which communicate with the interior. I soon found that doors were opened and closed before and after every exit from the nest. The process is a long, careful, and complicated one."

"What did the gates look like?" asked Harry.

"They are simply little heaps of dry leaves, twigs, and such like refuse, which are seen scattered here and there over the mound as one approaches it in day-time. (Fig. 91.) When I first saw them, as I have told you,

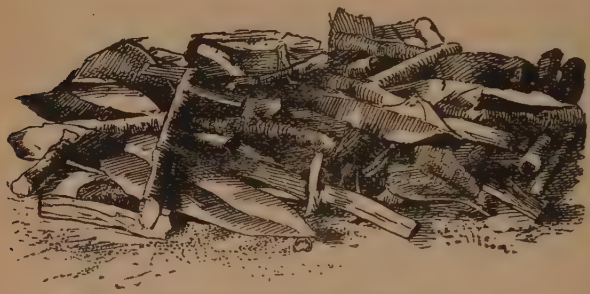

FIG. 91.—THE GATE CLOSED.

I was completely deceived, and thought them nothing more than accidental accumulations. I found out, however, that these piles were raised above the surface opening of the galleries that penetrated the mound, and that they filled the mouths to the depth sometimes of an inch and a half. The leaves and chips were intermingled with pellets of soil, and occasionally below them the gallery was quite sealed with pellets. The galleries frequently slant inward from the gate, and at as great an angle as forty-five degrees. Sometimes they deflect a short distance from the top. These conformations allow more readily the process of closing, as they give a purchase to the material used.

"The doors are opened about dusk. First appear the

minims, the very small forms, creeping out of minute holes, which they have doubtless made by working inside, and deporting from the heap grains of sand. Presently larger forms follow, carrying away bits of refuse, which they drop a couple of inches more or less from the gate. This is a slow process, and apparently nothing is accomplished for a long time. But evidently the whole mass of plugging is thus gradually loosened. Then comes the final burst, with soldiers, majors and minors in the lead, who rush out, bearing up before them the rubbish, which flies here and there, and in a few moments is cleared away from the gallery and spread around the margin of the gate. (Fig 92.) These

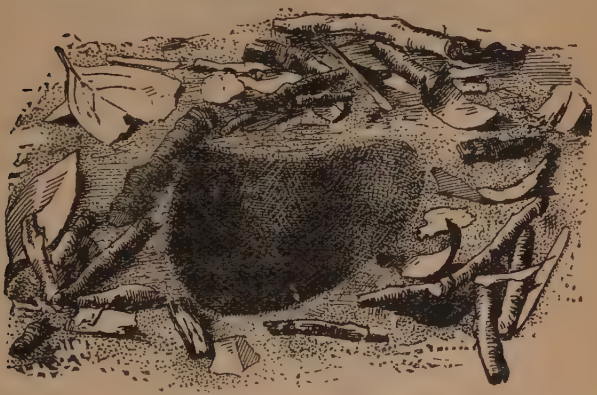

FIG. 92.—THE GATE OPEN.

chips are doubtless gathered together for this purpose, and are among the treasured properties of the ants being kept near by for such service. I easily identified

FIG. 93.—PREPARING TO CLOSE THE NEST.

many pieces as being thus used several days in succession.

"The doors remain open to give exit and entrance to the swarms of leaf-gatherers until morning when they are gradually closed, the process continuing in some cases until 10:30 A.M. In shutting up the house the minors appear to begin by dragging the scattered refuse toward the hole. One by one they are taken in, and the ingenuity shown in this is very great. My field note-book is full of sketches showing the progress, step by step, of gate-closing, and the admirable manner in which the workers proceed by properly adjusting the longest stalks and leaves that can stretch across and wedge into the mouth of the gallery, and then laying the shorter one atop of these. (Fig. 93.)

"But I cannot dwell upon these details. As the hole gradually fills up, the smaller castes of workers appear upon the field and take up the work to which their slighter frames are adapted. The last touches are carefully and delicately made by the minims who, in small squads, fill in the remaining interstices with minute grains of sand; and finally the last laborer steals in behind some bit of leaf, and the gate is closed. It then presents to the casual observer the appearance which I have described, and which is shown in the cut, of a small heap of dry chips accidentally accumulated upon the ground."

I was delighted to note the interest with which my friends followed this description, and how eagerly they hung upon my words. Several drew a deep breath and

uttered various exclamations as I concluded, and when I called attention to a figure which I had drawn, showing a gate when closed, and the same when opened, even Sarah left her recess in the shadow of the kitchen door to look at it.

"An' what do they go thro' all thet bother for?" at length she asked. I hesitated a moment, but observing that the question voiced the wish of others, was about to speak, when Dan took up the answer for me.

"Bress yo' heart, honey," he said. "What do *yo'* shet yo' doahs fer? Ef eber dar wur a 'tickler body on dat subject uv shettin' doahs, it's yo', Sairy Ann. An' I's done said, many en' many's the time, dat de 'mount uv bother 't yo'd make 'bout dem ole doahs uv yo's, is onreasonable out uv all perportion."

"Onreasonable!" cried Sarah, quite thrown off her guard. "That's the way with you men—allus the way. Do ye call 't onreasonable to keep flies out of the kitchen w'en ther wuss 'n the plagues uv Egypt; an' to keep draughts off 'n the bread dough, an'—but w'ats the use 'n talkin'?" She had retreated to her kitchen door by this time, and turned to hurl at her venerable tormentor a question which she was wont to shout at him many times a day. "I'd jist like to know w'at doors 'er made fer, ef not to shet?"

"Ho, ho," laughed Dan, clasping himself in his arms, and rolling his body in his usual way when greatly amused; "ho, ho! Dat's zactly wat de ants tink about it, Sary Ann! W'y didn't yo' start out wid dat quest'n, an' den yo' needn't 'v axed nuffin' 'tall."

When the amusement which this little episode produced had subsided, I resumed :

"At first I contented myself with looking for these gates in the near vicinity of the central mound or bed, but I soon found that there were many more openings. Indeed, one scarcely knew where he might stumble upon a group of the little miners crowding in busy groups out of holes in the grass, carrying pellets of earth, the product of their underground excavations. I never saw any but the smaller forms or minims engaged in this service of digging. They were night workers, and at times, as I moved over the ground thirty or forty feet from the central live-oak mound, I would see shining in the lantern-light among the grass a white 'dumping' which showed where a bevy of masons were at work. They had tapped the white adobe clay that lies several feet underneath the upper soil, and the nature of the pellets which they were carting out showed that they were cutting rooms and galleries in that stratum. The accumulation outside the opening presented quite the appearance of a mimic railroad dumping, with a gang of laborers at work ; the minims issued from the cavernous shadows trembling under the weight of the white pellets borne before and above their heads, crossed the heap until the edge was reached, and then 'dumped' their load. It was quite a comical sight to see some of them at this point. They raised themselves upon their hind legs, thrust their heads over the edge, and with a saucy jerk flung down the bit of clay. Others would put a fore-paw to

FIG 94.—AN EMMET "DUMPING"—A MASON SQUAD AT WORK.

either side of the face, and striking forward with the legs, accelerate the movement of the pellet. Others, again, contented themselves with simply thrusting the head beyond the margin of the dump and dropping their load from the jaws. Here is a sketch of one of these mason groups engaged on a dumping." (Fig. 94.)

"Certainly these little fellows have amazingly interesting parts," remarked Penn Townes; "but they must be a great plague to the horticulturist. Is nothing done to destroy the creatures?"

"Oh, yes, there are various ways for their destruction; indeed the formidable nature of the insects' depredations has developed a class of men whose special business is to exterminate them. I heard of one at Austin, who had long followed the business of digging out nests, and was known as the 'Old Ant Man.' I saw some of his work—great holes, the size of a small cellar, from which vast formicaries had been literally dug out. I heard of another person who, being of an inventive turn, had devised a machine which dispenses with the laborious method of the old Austin ant man. I was fortunate enough to get one of his circulars, and here it is, with the wood-cut to illustrate the mode of operation. The cut, to be sure, is of a most primitive type, and looks as though it also might have been manufactured by the inventor of the machine. But it is very interesting, if not artistic, for it gives us some insight of an ant-bed, as seen by an experienced practical observer. Of course he has only made a rough diagram of a nest-interior, but you

see that it shows a network of galleries, uniting caves of various sizes, just as I have described it. (Fig. 95.)

"The 'Insect Destroyer' works about in this wise:

FIG. 95.—A PATENT ANT EXTERMINATOR.—FROM THE INVENTOR'S CIRCULAR.

alternate layers of ignited charcoal and sulphur or similar materials are laid in a hollow dug around one of the gates, and surrounded by a 'smoke chamber.' In one case a bellows, in another an air-pump, is attached to this chamber, and as the combustibles are blown into a flame, the gas thus generated is also forced down the galleries into the rooms, and of course suffocates the ants. The inventor, as you see, here advertises 'the largest bed of Cutting Ants completely destroyed in twenty to forty minutes.'"

"Dear me!" exclaimed Abby, "that is surely a fell

destroyer! He must have got this hint of exterminating emmet cities by raining fire and brimstone upon them, from the story of Sodom and Gomorrah! But see! here is a confirmation of your account of the location of gates at distant points; our Texas artist has put little puffs of smoke curling up from holes way out here in the field."

"Does the machine work satisfactory?" asked Hugh.

"Really, I cannot tell you, though I tried to ascertain that fact. But, if you have a mind to experiment, note the advertisement: 'Price, for Farm-Right and Machine, all Complete, $20.'"

"Ther's nothin' to expurmint on," answered Hugh, laughing, "aroun' this ole farm, 'cept mole runs and a few rat holes aroun' the barn; an' I reckon it ud hardly pay to import a colony uv cuttin' ants jest to expurmint on *them*."

"I am sure that I wouldn't begrudge the money," said Aunt Hannah, "if the inventor would guarantee that his machine can smoke out our red house-ants."

"Red ants, Aunt Hannah!" exclaimed the Mistress. "You surprise me! I thought there wasn't enough encouragement in the way of stray crumbs of any sort around your house to justify even a red ant in venturing upon the premises."

"Catherine Mayfield," responded Aunt Hannah, with a little show of warmth, "thee must know that the matter of dirt has nothing to do with the presence of ants. They are tidy creatures enough and know how to pick up a living in the tidiest housekeeper's cup-

boards. There are some insects, I grant thee, whose presence is a proof of uncleanliness, but it is no discredit to any housekeeper to have red ants at times."

"An' that's the mortal truth, Aunt Hanner," remarked Sarah, who had been again allured from the kitchen shadows by the nature of the conversation. "I've tried no end uv scourin' an' scrubbin'; an' after I'd hed my closets all swep' an' garnished, and polished to boot, along ud come them pesky mites uv critters, like the cast out devils in the Scripter, an' ud enter in bringin' ther neighbors with 'em, an' make things wuss 'n ever. For my part I don't see w'at *sich* anymiles wuz made fer, nohow!" Having thus delivered her mind and started a problem that has puzzled wiser heads, she returned to her seat at the kitchen stove.

CHAPTER XV.

THE CRICKET ON THE HEARTH.

THE subject of two of our most interesting Conversations—the Music of Insects—was introduced by a casual discussion between Sarah, Hugh and Dan. The autumn air, ever since our advent to the old farm, had been full of the shrilling of crickets, and the noisy vocalization of katy-dids. As the Fall advanced the notes grew fewer and fainter. Silence fell upon the air after the light, early frosts, which was broken once more when the returning warmth of October's mellow suns allured the insects from their refuge in holes, under stones and in crevices of trees. The call of the katy-did at last ceased ; the crickets creaked on through the dreamy haze of Indian summer, then fell into silence over all the fields, leaving only here and there a fortunate adventurer to push his way into human habitations, and from the shelter of friendly wall-crannies or the warmth of a log-fire figure with his monotonous chirrup as the "Cricket on the Hearth." (Fig. 96.)

One evening Hugh and Dan were sitting on the bench beside the back-kitchen door, smoking their pipes and exchanging views upon the merits and demerits of insects of various sorts. One of the pleasant results of our Conversations has been to supply our regular and

occasional workmen with a theme for intelligent discussion. We have been surprised—as they themselves have been—to see how much they have been stimulated to observe the natural objects and phenomena which continually fall in their way. Before this Fall these had been nearly disregarded, or passed with a careless eye, and usually with a wrong idea of their nature and relations. Now, everything about the farm, especially of an insect kind, is sharply scrutinized. These observations are compared and canvassed among themselves, and often referred to me for decision and further information.

We congratulate ourselves on this result, because whatever quickens the intellectual life of working people, or induces them to close and careful observation of matters around them, and deepens their interest in the world through which they move, goes very far to raise the quality of the laborers and enhance the value of their service. Certainly, this is an incidental result; one, indeed, that we had not counted much upon; but the fact that the happiness and intelligence of my humble friends have thus been promoted has been a strong stimulus to me to persist in my course.

One of these discussions was in full progress between Hugh and Dan on the evening to which I allude. Sarah was busy at the kitchen table that stood by the open window just above the bench on which the men sat, and so could join in the conversation without interrupting her work. A lull in the talk gave her an opportunity to change the subject to one on which she

evidently had strong views—crickets. She took her stand on the kitchen stoop, for better effect in uttering her opinion, and with hands (one of which grasped the dish-towel) resting in a favorite attitude upon her hips, she began:

"It's all werry well to talk

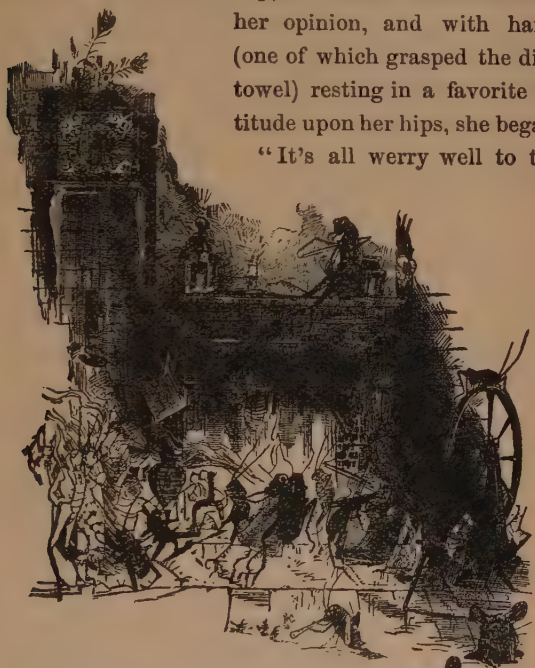

FIG. 96.—THE CRICKET ON THE HEARTH.

about the peert habits an' sich uv them critters, but ther's one inseck that I hain't no use fer no how, and thet's the cricket."

"W'y, w'at's the matter 'th the cricket?" asked Hugh.

"Its eternal *creak, creak, cree-eek!* That's w'at's

ine matter! I can't abide it. 'T seemed to me that ther wus a dozen uv 'em in my room last night, an' I never closed my eyes a blessed minit fer the noise they made. Tho', fer thet matter, I reckon ther' wan't more'n one atter all. But, lawsamassy! w'at a *cree-cree-cree-in'* it did keep up!"

The cook bent forward, and made such an odd, emphatic, and indignant imitation of the cricket's chirrup that the men laughed aloud.

"Oh, yes; it's mighty nice fer folks as sleeps like posts 'n piilars to laugh at others, but if you wus as restless o' nights as I am, an' 'ad been robbed uv a whole blessed night's sleep, ye'd laugh on t'other side uv your mouths, I kin tell you."

Sarah was notoriously a sound sleeper, but that fact did not prevent her from indulging an infatuation which has fallen upon many wiser people, of lengthening a few wakeful moments into as many hours. It is curious how people lose the power of computing time in the dark!

"But that isn't the wust o' crickets—ther noise ain't," continued Sarah. "I'd most as lief hear a hoot-owl ur a whip-poor-will under my windy a-nights as hev a cricket a-creak-creakin' in my room. It's an omen uv death to some one uv the family, ur some near relation, and it jest sets me all uv a chill to hear 'em. I'd like to kill the whole nasty, coffin-creakin' brood! Thet's my opinion about crickets!"

"Well, Sarah!" said Hugh, puffing a cloud of smoke into the air, "if that *is* so, I guess there mus' be an

awful mortality goin' on purty stiddy among folks's relations in these parts, fer I never know'd a Fall around here that the crickets didn't holler like the nation. W'y the fields's full uv 'em, and some uv 'em alluz manage to creep in doors. Now, fer my part, I alluz heerd tell that the cricket was rather lucky'n otherwise."

"So't is, Sary Ann, so't is," said Dan. "Yo's all out dar 'boout de crickets."

"W'at do *you* know about crickets, *I'd* like to know?" exclaimed Sarah, evidently scenting a controversy.

"I knows a heap, Sary Ann—a heap!" was the rejoinder.

The old man took a deep whiff of tobacco, then folded his arms over his knees, lowered his body upon his arms, and shutting his eyes, dropped into a droning, subdued tone, as though he were speaking to some one in the air.

"W'en I was a pickaninny, in ole Marylan'," he said, "not mo'n knee high to a duck, my mammy—a Virginny woman she wuz—wunst cought me killin' a cricket. I kin see des's plain's day de awful look on 'er face es she grabbed me, en signed de cross ober me, en den shuk me tel I farly chatter'd.

"'Doan ye nebber do dat agane, chile,' she said. She wuz so skeered thet she panted fer breaf, and could skarcely speak a word. 'I know ye done 't widout a-thinking, but hit's awful wrong to kill crickets, 'spec'lly dem as 's in dohs. Dey's *de sperits uv ole*

folkes, honey! She drapped her bref en spoke'n a whisper 'et farly made my blood run cold. 'Dat's w'at dey is, chile—ole folkses w'ats dead'n gone, en done come back to sit in dar ole co'ner by de kitchen hearth. Dey hadn't otter be harmed, en woe's dem w'at kills 'em.' Dat's jes w'at she said, en I 'member hit es though it happened yestahday."

Dan slowly raised himself, took a deep, long pull at his pipe, then closing his eyes, again resumed in a low, solemn tone: "Dat—bery winter—*my mammy died!* an' to make t'ings wus-'n-wus, de nex' summer ole Mars sot all his niggers free, 'en we uns uz moved up hyar inter Pennsylvany. Hit allus 'peared to me, ahter dat, ez dough I wuz 'sponsible somehow fer po' mammy's def, en fer hevin' to leave ole Marylan', too. I's been back dar sence, but my ole 'oman she wouldn't stay; but dar's no kentry like a-dat. Dat's w'y I says, Sary Ann, et I knows a heap aboot crickets. An' I *does*, I kin tell ye!"

Sarah was silenced. She was so keenly sensitive to the class of emotions that Dan's tale was calculated to stir up, that she sat down upon the stoop quite subdued. Hugh Bond, however, was not much given to superstition. He had, indeed, imbibed some of the notions current among his class, but held them in a very superficial way, more as an indifferent habit of thought than with any sincerity of faith. Dan's story, therefore, made no serious impression upon him. Indeed he was rather amused by the manner of his old companion, and the effect of his tale upon Sarah.

At last he broke the silence :

"Well, Dan, that's certainly a solemn account of things. But, accordin' to my mind, you hain't made out a very clear case agin the crickets. It looks to me about as broad's long, an' a leetle more so. If the crickets wuz responsible fer affairs at all, the loss uv your mammy is purty well balanced by the freein' uv all your master's slaves. You don't 'pear to reckon much on that, I 'low ; but, I rether 'spect thet you wouldn't find many uv the party to agree with you ; an' I 'magine you'd sing another tune yourself ef you'd had to take the changes and chances uv a slave's life.

"I remember hearin' somethin' uv this talk about crickets w'en I was a boy, but as I recolleck it was kind of betwixt an' between your notion and Sarah's. It was about like this : If crickets has been livin' in a house fer a long time, an' then up an' leaves uv a sudden, it's a sign that some evil 'll befall the family, p'r'aps the death uv some member. But then, on the contrary, the return uv these insecks after they've been absent is a sign uv good luck ; in fac', I allus heerd that the very presence uv crickets wuz counted lucky.

"But the way I look at it, there's a heap o' humbug about the whole thing, not to call it wus'n that. Now, jist think a minit. Here we are, callin' ourselves Christian folks, an' believin' in a Providence thet rules the world. An' yit we sit down an' talk uv the Father Almighty Ruler uv Heav'n an' earth turnin' roun' and killin' off a poor ole woman all along uv an innocent baby killin' a cricket. Fer my part I hain't no notion

that the Lord consults crickets ur any other sort uv bug about the gover'ment uv human beins. But supposin' we ax Mr. Mayfield about this matter. He's chock full uv all kin's uv inseck larnin', an' 'll straighten it out fer us."

So it came about that the crickets were made the subject of an evening's discourse, and the topic broadened out into "Insect Music." Fortunately, Dr. Goodman had an engagement to preach and conduct a children's service in the "Blue Church," a free place for public religious service in our neighborhood, and as he was to be our guest, drove over Saturday afternoon, and was thus present at our Conversation.

"Without stopping at present," I began, "to settle the points raised concerning the popular notions about crickets, I would like you first of all to know something about the natural history of the insects themselves. They belong to the sub-order Orthoptera, which may be briefly characterized as having free biting mouth parts, with highly developed organs of nutrition and digestion. The first pair of wings are somewhat thickened to protect the broad net-veined hinder pair which fold up like a fan upon the abdomen, and the hind legs are large and adapted for leaping. The larvæ and pupæ are both active, and closely resemble the imago or perfect insect. All the species are terrestrial, having no qualifications for water life, and the most typical forms have remarkable powers of flight, besides leaping powerfully. The grasshopper is the type of the group, and some of its best-known forms are the crickets, grasshoppers,

locusts, mole-crickets, katydids, cockroaches, walking-sticks or spectres, and mantis or soothsayers."

"Why are these insects called Orthoptera?" asked Abby.

FIG. 97.—WHITE CRICKETS, MALE AND FEMALE, FROM NATURE. REDUCED ONE-THIRD.

"The word is composed of two Greek words—*orthos*, straight, and *pteron*, a wing. The Doctor is quite familiar with the first of these in the theological com-

pound—orthodoxy. The name 'straight wings' is given because their wings, when not in use, are folded lengthwise in narrow plaits like a fan, and are laid straight along the top or sides of the back. You will notice this by looking at these prepared specimens, which I have brought for our use this evening. We have several species, natives of our section, representing three genera, and besides these the common European house-cricket (*Gryllus domesticus*), which has figured so largely in song, story, and superstition, has been imported and domesticated in some parts of the country. These differ quite widely in their habits, some being solitary, some social, some dwelling in the ground, some living upon trees, some nocturnal, others loving the day.

"The story of their development is about as follows: Most of them deposit their numerous eggs in the ground, making holes for their reception with the long spear-pointed piercers with which the females are provided for this purpose. The eggs are laid in the autumn, and do not appear to be hatched until the following summer. One of our species, the White Climbing Cricket (*Œcanthus niveus*), differs from her sisters in egg-placing (*ovipositing*). She makes several perforations in the tender stems of plants, and in each puncture thrusts two eggs quite to the pith. These are hatched about midsummer, and the young immediately issue from their nests and conceal themselves among the thickest foliage of the plant. This kind of cricket inhabits the stems and branches of shrubs and trees,

concealing itself in the day time among the leaves or in the flowers. It is to this habit that the generic name is due (*Œcanthus*), a word which means inhabiting flowers. (Fig. 97.)

"After hatching, the young crickets, in common with all the Orthoptera, very closely resemble the adult insects in form, and differ from them chiefly in wanting wings. They move about and feed precisely like their parents, but moult or change their skins repeatedly before they come to their full size. This corresponds to the grub or larval stage in other insects.

"The next stage is also quite different from that of moths, butterflies, and beetles. These insects, you have already learned, pass into a state of inactivity and rest, in which they lose the grub-like or larval form which they had when hatched from the egg, and become the pupa or crysalis. This resembles a little more nearly the mature form, but is soft, whitish, and with the undeveloped wings and legs incased in a thin, transparent skin, which impedes all motion."

"Do we understand you to say," asked the Doctor, "that the cricket does not pass through the crysalis stage?"

"Precisely. On the contrary, in the pupa state crickets do not differ from the young and from the old insects, except in having the rudiments of wings and wing-covers projecting, like little scales, from the back near the thorax."

"And is that the case with all the Orthoptera?"

"Yes; grasshoppers, katydids, locusts, and all the

rest have the same peculiarity in their development. These Orthopterous pupæ are active and voracious, and increase greatly in size, which is not the case with insects that are subject to a complete transformation, for such never eat or grow in a pupa state. If you will catch a dozen grasshoppers and locusts at a venture, in a mid-summer field, you may easily notice these differences in size and in the length of wings, showing the adult from the less mature forms. When fully grown the Orthoptera cast off their skins for the sixth or last time, and then appear in the adult or perfect state, fully provided with all their members, with the exception of a few kinds, which remain wingless. In fact, the slight changes which crickets and all the Orthoptera undergo in their progress to maturity are nothing more than a successive series of moultings, during which their wings are gradually developed."

"I have seen it stated," said Abby, "that we have no house-crickets in America. And indeed I cannot remember ever to have heard them in-doors in my native State, Massachusetts."

"Dar's plenty uv em in ole Marylan', 'tany rate," observed Dan; "dat am a fac', I shore yo'—fiel'-crickets en house-crickets, too. En es to bein' hyar in Pennsylvany, jes yo' ax Sary Ann dar! W'y deys lots on 'em in dis hyar ole place!"

"Yes, and there is nothing better known to the country people of our border states than the 'Cricket on the Hearth;' I have often met them in the West inhabiting chimney places and first-floor apartments of dwellings.

My experience of old Pennsylvania houses in autumn is not very extensive, but I have met them here, and know certainly that they abound."

"I have never passed a winter," said the Doctor, "without hearing their music in our parsonage, and I have often heard it in my various preaching tours while domiciled in country hotels and houses."

"Hark!" cried the Mistress, springing to her feet. The suddenness of the movement and the sharpness of the exclamation startled us all into silence. Every eye was turned wonderingly upon the Mistress, who stood erect in the ruddy glow of the hickory-wood fire, pointing with one arm toward the upper corner of the chimney.

"*Crick-crr-rr-ick!—rr-r-rick!*"

The silence was broken by a shrill, creaking note issuing apparently from a pot of artificial flowers that stood on one side of the broad stone mantle-piece.

It was the "Cricket on the Hearth!"

A merry laugh and a hearty round of applause from clapping hands greeted the advent of the little musician whose timely note had now settled the question which the Schoolma'am had raised.

Old Dan looked up from his low perch, and rolled his eyes and rocked his body in ecstasy. "Dar it be, dar it be!" he exclaimed. "Dar's good luck shore to de noo family in de ole house. De sperits uv de ole folks hes come back, en dar's a blessin in it! Hi, yi! Ho, ho, ho!"

Dan's speech awoke a fresh burst of merriment, in

the midst of which Aunt Hannah's reproving voice was heard: "Daniel, Daniel! thee is too provoking with thy childish superstitions. Thee has been taught better than that by the good Friends who once sat by this hearth-stone, and whose spirits are in a Better Home or they would surely grieve over thy folly."

"Well, Aunt Hannah," I said, interrupting the silence which this remark had caused, "we musn't be too hard upon Dan. You know the proverb, 'It's hard to teach an old dog new tricks.' At all events we are much obliged to our little friend in the chimney corner for this very remarkable and timely contribution to our conversation. For my part I shall accept it as a good omen, without endorsing Dan's peculiar notion as to 'sperits.'"

Aunt Hannah shook her head soberly; but the Mistress looked up with a happy and approving glance, and I turned once more to our subject.

"Crickets, are for the most part, nocturnal and solitary insects. That is, they live alone, concealing themselves by day, and come from their retreats to seek their *food and their mates by night.* They sit at the doors of their caves and chirrup away for hours together. The hearth-cricket belongs to this class. Our common species are the short-winged Gryllus (*Gryllus abbreviatus* Serville), which is about three-quarters of an inch long, of a black color, with a brownish tinge at the base of the wing-cover, which is sometimes wanting in the male; the Black Cricket, or Pennsylvania Gryllus (*Gryllus Pennsylvanicus* Burmeister), which is quite black, and

measures six-tenths of an inch in length (Fig. 98); and *Gryllus neglectus* Scudder, which differs from the last-named by having a shorter ovipositor.

"Then there are the field-crickets. Besides the white climbing cricket (*Œcanthus*), which I have mentioned,

FIG. 98.—BLACK CRICKETS (GRYLLUS NIGER), FROM NATURE, REDUCED ONE-FOURTH.

there is a wingless species (*Nemobius vittatus*), the Striped Cricket. It is very small, about four-tenths of an inch long, and varies in color from dusky brown to rusty black. This is a social species whose individuals associate in great swarms, feed in common, frequent our meadows and road-sides, and so far from shunning

daylight, seem to be as fond of it as other crickets are of darkness.

"Now we are ready to consider how and why the crickets make their music. The old insects, for the most part, die on the approach of cold weather; but a few survive the winter by sheltering themselves under stones, or in holes secure from the access of water. Of these are the solitary stragglers who make their way into our houses, and warmed up by the genial fire to some dim suggestion of summer, are awakened into a sense of their forlorn estate, and creak out their loneliness to some imagined mate. The same sounds are heard over all our fields, and almost without cessation from twilight to dawn during our autumn months. There is no music in summer, for pairing does not begin until Fall, and the cricket's music is a love-call. It is the male's signal to his mate, and if ever there was a persistent, vociferous and self-satisfied serenader it is he." (Fig. 99.)

"Do you tell us that the female doesn't sing?" asked Abby, with some surprise.

"Neither males nor females *sing*, for the insects have no vocal organs. But the gift of music, such as it is, is bestowed upon the male alone. Whether Madam Cricket is a loser thereby may be doubted, but the human species is the gainer; for, if Nature had endowed both sexes with the power of shrilling, the night discords would have been scarcely bearable."

"Does that fact apply to all Orthoptera?" asked the Doctor.

FIG. 99.—THE WHITE CRICKET'S SERENADE.

"Yes, grasshoppers, katy-dids and locusts all keep their music-making among the males."

"What a strange contrast with the human family!" said Penn. "With us now the sweetest singers are always of the fairer sex."

"Are you quite sure of that?" suggested the Doctor. "Is not that statement drawn from your courtesy rather than from the actual facts? If one were to follow the subject throughout the various races of men, or even trace it among civilized nations, it might be found that at least the chief music-makers of our own species are of the male sex. Certainly, it cannot be questioned that the great masters of music are and have been men. In the more perfect and complex organization of mankind it is a matter of course that the song-gift should be largely shared by the female; but the primative order of Nature, as Mr. Mayfield has shown it to us in the male insects, is probably so far preserved as to give man superiority over woman as a music-making creature—a superiority which is most unquestionable in the matter of instrumental music. It occurs to me, however, that there is here an analogy even more curious and striking. It is remarkable that among mankind also music has ever found and still finds one of her widest spheres of use in affairs of the heart. It is the natural expression of the deepest passion that men as well as insects know—love. The soul of music is emotion, and the profound passions of love, religion, and joy of victory have ever been voiced in rythmic speech and melodious notes."

"I have been thinking," observed Penn, apparently addressing himself to his mother, "that if music has such a noble origin and use in nature as to utter the love of one creature for another, the testimony which our people—the Friends—bear against it might well be reviewed."

"Our people," answered Aunt Hannah, "bore their testimony chiefly against the unspiritual and carnal use of music in the worship of God, and I do not perceive that the world has ceased to have need for a clear testimony in that particular. Perhaps our fathers carried it a little too far when they opposed the private use of music, but thee knows that human nature is apt to go to extremes, and the wise and good men of old chose to be at least on the safe side.

"I will not pretend to give an opinion upon the views of our learned friend the Doctor. They may be true; but I can say that I know people who have a very intense power of loving who have no music in their souls; and some who can sing to the fullest admiration of the world's people who are as shallow in their affectional natures as a babbling brook. Now, I wouldn't expect thee, Penn, if thee should ever fall in love, to vent thy feelings in a moonlight serenade, for thee knows thee can't tell 'Yankee Doodle' from 'Old Hundred,' or 'Home, Sweet Home' from 'Rosin the Bow.'"

Penn blushed deeply under this home thrust, while his mother continued: "And yet I know that thee has a very deep and tender nature. But all this is out of place, perhaps, and, if I am not mistaken, out of point,

FIG. 100.—DAN'S IDEAL CRICKET ON THE HEARTH—SARAH BLOWS THE CONCH-SHELL FOR DINNER.

too. For what argument can one draw to any subject pertaining to *music* from the discordant, ear-piercing creaking of a cricket? Quaker as I am, I would be sorry to dignify such noise by so high a title."

"Oh, no!" exclaimed the Mistress, "don't say that! On the contrary, I love the cricket's chirrup, and think it very sweet music, indeed. But there is no accounting for tastes, and no reconciling them in this matter as in many others. What is music for one person is clamor and discord to another."

"Dat is jes so!" said Dan, who appeared to be much impressed by the last remark. "I was remarkin' dat t'other day wen some one sayed dar wahn't no music en a conk-shell. Now, fer my part, w'en I's hungry and tired wurkin en de harves' fiel' and Sary Ann comes out to de ba'n yard, an blows dat conk uv hern fer dinna', an' de toot-too-too! comes a rollin' ober de fiels, hit seems to me dar's no music out ob Canaan et's sweeter'n dat. *Dat's* de kin' ob cricket on de hearf dat suits *my* taste—jes' at dem times."

Sarah scarcely knew whether to receive as complimentary or the reverse Dan's comparison of herself and her conch-shell to an insect that she detested; but finally joined in the laugh which the conceit had occasioned.

By-the-way, this old-fashioned dinner-call which used to be popular among farmers' wives in early days in Pennsylvania, is one of Sarah's particular vanities. The conch is her own property, and she brought it with her to our service, pleading for its use at least

when the workmen were afield. The oddity pleased the Mistress, and indeed we all now have a sort of pride in Sarah's shell, which she sounds not only with thorough gusto but with the skill of a Triton. In my rambles I have often heard with high satisfaction its midday or evening notes, mellowed by distance and associated with home and good fare, echoing over the meadows and through the waving corn.

Sarah keeps it suspended upon a rustic bracket of oak-forks above the kitchen hearth, so that Dan's metaphor had a special appositeness which the family at least appreciated.

"Isn't it time for us to go back from our digression?" I suggested. "If you are quite satisfied with your philosophizing over the cricket's music, suppose we turn our attention to the question how the music is made."

CHAPTER XVI.

MUSIC-MAKING INSECTS.

THE instruments by which the male cricket produces the sounds which have given such celebrity to this insect, form a part of the wing-covers. The base or horizontal and overlapping portion of these organs near the thorax is convex, and marked with large, strong, and irregularly curved veins. These veins run through the middle portion of the wing. When the cricket chirrups or shrills he raises the wing-covers a little and shuffles them together lengthwise, so that the projecting veins of one are made to grate against those of another. If we seek an analogy for this action among musical instruments we must select the violin, whose sounds are produced by the rubbing of the bow against the strings, or the banjo, harp and guitar, whose sounds are evoked by striking the fingers upon the strings. In fact it is quite as much like a file or a watchman's rattle.

"Do all insects make their music in the same way?" asked Abby.

"The sound-producing organs are constructed on the same general principle, but there is much difference in details. In the katydid for example, the musical instruments are a pair of taborets. Most of you are quite

familiar with the note of this insect, which is one of the best known sounds of our autumn evenings. The appearance of the insect is less familiar. Here it is. (Fig. 101). This is a large insect, measuring from the head to the ends of the wing-covers more than an inch and a half; the body is an inch long, is of a pale green color, the wing-cover and wings being somewhat darker. Its thorax is rough like shagreen, and has somewhat the form of a saddle, being curved downward on each side, and rounded and slightly elevated behind. The wings are rather shorter than the wing-covers, and the latter are very large, oval and concave, and inclose the body within their concavity, meeting at their edges above and below, something like the two sides or valves of a pea-pod. The veins are large, very distinct, and netted like those of some leaves. There is one vein of larger size running along the middle of each wing-cover resembling the mid-rib of a leaf.

"The taborets are formed by a thin and transparent membrane, stretched in a strong, half oval frame in the triangular overlapping portion of each wing-cover. When the male wishes to sound his call, he opens and shuts the wing-covers so that the frames of the taborets rub rapidly and violently against each other. The mechanism of the taborets and the concavity of the wing-covers reverberate and increase the sound to such a degree that it may be heard in the stillness of the night at the distance of a quarter of a mile.

"The music of the katydid is certainly remarkable considering how it is produced. It consists of two or

FIG. 101.—KATYDIDS: MALE (UPPER FIGURE) AND FEMALE. NATURAL SIZE. FROM NATURE.

three distinct notes, almost exactly resembling articulated sounds. These correspond to the rapidity with which the wing-covers are shifted across each other, and the note produced is very well expressed in the popular name of the insect."

"Are the katydids nocturnal insects like the cricket?" asked Abby.

"Yes; during the daytime they are silent, and conceal themselves among the leaves of trees; but at the approach of twilight they quit their lurking-places and mount to the tops of the trees in which they live. Then the males begin the tell-tale call with which they enliven their silent mates. The noisy babble breaks forth from neighboring trees, until all the groves at last resound with the rival notes of '*Katy-did it, katydid!*' The amorous concert continues the live-long night, and at the break of day the serenaders creep back to their leafy covert."

"What is the scientific name of the katydid?" asked the Doctor.

"It is somewhat formidable—*Platyphyllum perspicillatum;* but the generic name, which means *broad-wing*, is quite expressive, as you may see by a glance at the insect.

"The story of katydid's development is but a repetition of the cricket's. It is found in the perfect state during the months of September and October, at which time the female lays her eggs. These are about an eighth of an inch in length, and resemble tiny, oval bivalve shells in shape. The insect lays them in two

contiguous rows along the surface of a twig, the bark of which has been previously shaved off or made rough with her piercer. Each row consists of eight or nine eggs, placed somewhat obliquely and overlapping each other a little, and they are fastened to the twig with a gummy substance. In hatching, the egg splits open at one end and the young insect creeps through the cleft. Its history after that, as I have said, quite resembles that of other Orthoptera."

"Are the katydids and crickets injurious to vegetation?" asked Penn.

"The katydids do little harm; but crickets when they abound do much injury, eating the most tender parts of plants, and even devouring roots and fruits when they can get at them. Melons, squashes and potatoes are often eaten by them, and the quantity of grass that they destroy must be great, judging by the immense numbers which are sometimes seen in our meadows and fields. They are not strict vegetarians, however, but devour other insects when they can overpower them."

"Are not crickets, like katydids, named from the character of the note which they sound?" inquired Abby.

"Undoubtedly," answered the Doctor; "and it is a curious fact, and one quite suggestive as to the natural origin of a certain class of words, that the note of this insect has suggested its name in several other languages. The French *cri-cri*, the Dutch *krekel*, the Welsh *cricell* and *cricella*, are, like the English *cricket*,

evidently derived from the *creak*-ing sounds which the insect makes."

"Speaking of this community of ideas among various nations reminds me," I said, "of an odd trick at which I saw Harry and one of his little friends engaged a few evenings ago while crossing the Brook Meadow. They were fishing for crickets——"

"Fishing!" exclaimed the Mistress. "Didn't you tell us that they and other Orthoptera were not at all adapted to the water, which they shun?"

"True; and I am glad that the lesson is so well remembered. The boys' fishing was confined to the earth-holes in which the crickets live. They had ants and flies fastened to a long straw, which they thrust down the hole. The cricket is a combative as well as a musical animal, and can often be brought out of his den simply by intruding the naked straw; but bait proves an additional attraction. Now, the point worth noting about this is that the French children amuse themselves by the same method of capturing crickets. Indeed, the fact has given rise to a proverb quite common in France, *il est sot comme un grillon*—he is silly as a cricket! More than that, as early as the days of Pliny a similar practice was in vogue, for that author tells us that the manner of hunting and catching these insects was to tie a fly at the end of a long hair and let it down into the cricket's hole, first taking the precaution to blow away any dust that might prove a refuge for the bait. The cricket spies the fly, seizes and clasps it around, and so they are both drawn forth together."

"That is certainly a curious coincidence," said the Doctor. "And it is a most interesting point to consider whether this and such like tricks and games of children have been preserved and distributed by tradition, through all these years, and among the various peoples where they obtain, or whether they have sprung up spontaneously in the youthful minds of various nations and ages. In either case we have a fact looking towards the common origin and unity of the human race."

"Don't forget, Mr. Mayfield," suggested Hugh, "that leetle question between Dan and Sarah as to w'ether crickets bring good or bad luck."

"Thanks for the suggestion; I have not forgotten it. But as this subject is rather more in the line of Dr. Goodman's studies than mine, I took the liberty of referring it to him. Are you ready to respond, Doctor?"

"To be quite candid," he answered, "I have not been able to do very much, although I know there must be a great deal of material scattered through literature, if one could only lay hands on it. However, I have brought a few notes. Gilbert White, in his 'Natural History of Selborne,' an old-fashioned but to me still delightful book, speaks of crickets thus: 'They are the housewife's barometer, foretelling her when it will rain, and are prognostics sometimes, she thinks, of ill or good luck, of the death of a near relative, or the approach of an absent lover. By being the constant companion of her solitary hours they naturally become the objects of her superstition.' This appears to decide the

controversy in favor of both parties, a highly satisfactory decision."

"There," exclaimed Sarah, whose interest in this point had once more withdrawn her from the shadow of her kitchen door, "didn't I tell you so, Dan? The cricket's chirp *is* a sign uv ill luck—the death uv a near relation. I knowed I 'uz right!" And she returned in triumph to her seat.

"Hol' on, Sary Ann!" said Dan, "dat's no fa'r! Didn't dat aufer 'low dat de cricket brot good luck, too, Doctor?"

"Yes, he certainly does; and here's more on your side of the question, Dan. Milton, in his 'Il Penseroso,' chose for his contemplative pleasures a spot where crickets resorted, and he speaks of that insect's note as the one token of merriment in the place:

> 'Where glowing embers through the room
> Teach light to counterfeit a gloom,
> Far from all resort of mirth,
> Save the cricket on the hearth.'

"Is that the origin of the popular phrase 'Cricket on the hearth?'" asked Abby.

"Really I do not know; but it is the source from which it is generally quoted. In the same strain, and more decidedly, the poet Cowper writes, in his 'Address to a Cricket,' chirping on his kitchen hearth:

> "'Wheresoe'er be thine abode
> Always harbinger of good.'

"The best-known allusion is found in recent literature. Most readers of Charles Dickens will remember

how he embodies the popular superstition in his little tale 'The Cricket on the Hearth.' When the carrier's young wife hears the familiar note in the chimney-place, she exclaims: 'It's sure to bring us good fortune, John! It always has been so. To have a cricket on the hearth is the luckiest thing in the world!' That seems to be the most prevalent superstition. I also find reference to the peculiar form of the superstition which Hugh Bond remembers. Sir William Jardine alludes to it in *The Mirror* as common in Dumfriesshire. These are the most interesting points which I have been able to note."

"Sary Ann!" exclaimed Dan, wheeling his cricket around, and gazing into the kitchen shadows, "Sary Ann, did yo heah dat?" There was no reply.

"Sary Ann," persisted the old man, "Is yo' done loss yo' tongue? W'y doan yo' speak up, den? Hi! *Didn't I tole yo' so?*"

But there was no response. Sarah had appropriated her portion of the decision, and was too well satisfied to review the case. Well, she is not alone in this attitude: Why should a man care to hear more testimony, or to have more light, when *his* opinion has once been reasonably well confirmed?

Dan, unable to evoke any response from the oracle of the kitchen, turned back to his place, made a significant gesture upward with his eyes and hands, and chuckled softly to himself.

"Are there any superstitions associated with the katydid?" asked the Mistress.

"I am afraid that I must refer that question to Dan," I answered, laughing. "The only items in that line which I ever heard or saw, I received from him. Come, Dan, here's a good chance to air your ghostly learning. Tell us what you know about katydids."

Dan was never known to deny himself a good opportunity to talk, and readily assented; but he felt bound to free himself from what he considered an imputation of illicit knowledge.

"De good Lor' forbid, Mars Mayfiel'," he began, "dat I should have anythink to do wid ghos'es. I nebber seed a ghos', bress de Lor'! I's heern tell uv folks as ud done got dey knowledge from de ebil sperits; but, sah, I nebber eat ob dat forbidden fruit. No, sah, nebba!"

He placed his hands on his knees, sat bolt upright, and uttered the last words with great emphasis, and a comical show of dignity.

"All de larnin' I has 'boot dese tings I done larned from ole Marylan' and Virginny folks. I come up hyar w'en I wuz a pickaninny; but I went back to de ole state, and lived dar five year. Dat's whar I larned aboot sich tings; not from ghostesses, fore goodness, Mars Mayfiel'! Aboot dem katydids, 'taint much et I know, but dis is hit: If a katydid comes inter de house, dat's a sign, dey say, et a visitor'll soon come widout bein' 'spected. Ef it sings in de house, dat's a sign some ob de family'll be shore to hab de gif' ob music, like de banjo or pianner, ur dat like.

"Den, dar wuz a cur'us story 'boot two sisters wat

fell bof in lub wid one man. I doan' tink dis happen in ole Marylan', but in some kentry ober de sea, I reckon. De gemmen's name wuz Osca', an' de ladies' wuz Blanche an' Kate. Ob course, no man can lub two mars'rs, as de Scripter says, en it stans to reason he can't lub two misses, nudder. So Osca' falls in lub wid Blanche, an' Kate she gits soured, an' falls to hatin' her ole lubber. All ob a sudden Osca' done lay down an' died; an' seein' dat, Blanche she goes clar crazy, fur she lubbed him powerful, an' raved, an' raved. Dar wuz a great mystry 'boot de whole affah. Nobudy know'd anythink 'boot it but Miss Kate. She know'd mighty well, fur she'd a-killed Osca' herse'f!

"In dem fur-away times dey wahnt no true 'ligion as dey is nowadays, an' so de people ob dat kentry dey had a god w'at dey calls Jup'ter. Now, Jup'ter he sees how tings was a-goin', en he done tuk de sperit ob young Osca', wat Kate had a-murdered; an' wat does he do but turn it inter a katydid? An' he sots 'im up on de tree-tops war Miss Kate wuz a-walkin' wid some folks. Jes' den dey wur a-talkin' 'boot how suddent like de young man ud died; an' some un 'lowed he reckoned Osca' mought've bin *pizened.*

"'Who could a done it?' he says, awful solemn like. And nobudy answered; 'kase, yo' see, dar wahnt no 'spicions ob foul play 'gin Miss Kate in de least. Jes' den, in de mids' ob dat solemn silence, de new inseck—dat's de sperit ob Osca', yo' know—cried out from de tree-top, sharp, en loud, en suddent: '*Katy did it! Katy did! she did!*' An' dat's de way *dat* mudda wuz

a-found out, an' dat's how ebry wicked deed hab a voice cryin' out somewhar agin it. Dar's no use in talkin', mudda will out. Dat's all I know, ladies and gemmen', boot de Katydid."

"What became of Miss Kate?" asked Harry, with a child's natural yearning to hear the end of a story.

"Bress yo' heart, honey, dat story stopped jes' a-dar. I nebber heerd no end to it at all. But as Miss Kate wur a white lady, I reckon nothin' wuz ebber done aboot it; 'less dey woted her non compus, an' shet her up awile. But ef she'd a-been a cullud pusson, I reckon yo' mout a-guessed dey'd a-made short work ob her."

"Well, Dan," said the Schoolma'am, "that is a very interesting romance, certainly, and it carries an admirable moral. May I ask if these notions are held entirely by your own color in Maryland, or do the whites also hold them?"

"De cullud folks, Miss Abby," answered Dan, "hes many cur'us notions, dat's a fac, 'boot insecks, en aligators, en rabbits, en bars, en all sorts o' beastis. Some ob dem, I reckon, come frum dey native kentry, whar de sperits hes moh' to do wid sech critters, I s'pose, dan ober hyar in dis Christian lan'. But den de white people has some ob dem berry sayins, too. Hit's not all jes' niggah larnin, Miss Abby, no how."

It was now time, I thought, to bring back our conversation to the sphere of Natural History. Taking another insect box from the table, I opened it and

FIG. 102.—CICADA, FEMALE AND MALE (UPPER FIGURES.) LOCUST (LOWER FIGURES), ÆDIPODA CAROLINA. FROM NATURE.

began: "Here are specimens of the most famous of all the music-making insects — the Harvest-fly, or Cicada. Look at them, Hugh, and then hand the box to your neighbor." (Fig. 102, upper figures.)

Hugh glanced at the pinned specimens, and at once exclaimed: "W'y, sir, these haint harvest flies—they're locusts."

"Are you quite sure, Hugh?"

"Oh, yes, sir! I've seen thousands uv 'em—the seventeen-year locust. An' ther's another kind thet comes every year, or mebbe they're only sort o' stragglers. But I know 'em well, sir."

Several of the company were quite as positive as Hugh in their identification of the insect, and for a moment I found my entomological reputation in peril.

"Well," I resumed, "having sufficiently enlisted your attention, I may assure you that you are both right and wrong. You are right, according to the popular name of the insect, but utterly and grossly wrong as to the true title. There is about as much likeness between this creature and a locust as between a horse and a cow. There are few American entomologists who have not often been compelled to explain the wide and fundamental difference between these so-called "locusts" of the United States and the "true locusts" of Holy Scripture and our Far West. The latter (Fig. 102, below) really do often "eat every tree which groweth for you out of the field," as they did in the days of the plagues of Egypt; while the former having no jaws to eat with, and only a beak to suck

sap with are physically incapable of eating anything at all.

"The two kinds of insects do not even belong to the same order, or to the same grand group of orders. The former are "Suckers" (*Haustellata*); the latter are "Biters" (*Mandibulata*). The former belong to the order Homoptera, the latter to the order Orthoptera. The former have their front wings glassy and transparent; the latter have them more or less leathery and opaque. The former have a mere apology for antennæ, which the general observer would entirely overlook; the latter have quite conspicuous and rather long antennæ. In short, what people call "locusts" in America are called "Cicadas," or "Harvest-flies," in Europe; and what in the Old World are known as "locusts" are called "grasshoppers" in the United States. This popular error has been the cause of much confusion, and is greatly to be regretted; but one almost despairs of correcting the absurd blunder, at least in this generation.

"We have three or four species of Cicada in our country; two of these appear annually: a small spring Cicada (*Cicada rimosa*), which begins to be heard a little before the middle of June; and the large autumnal species (*Cicada pruinosa*), which is probably the best known of all. Then we have two periodical species: that remarkable and famous insect the so-called seventeen-year locust (*Cicada septemdecem*), and its close ally, the thirteen-year Cicada (*Cicada tredecim*). Few animals have so remarkable a history as the two last

named, but before we consider that, let us look at their musical organs, and compare them with those of the cricket and katydid.

"The males alone are musical, and their well-known rattling buzz is a love-call to their silent mates. The instruments by which the sounds are produced are a pair of kettle-drums, as they may be called, situated one on each side of the body. These can be plainly seen here just behind the wings. These drums are formed of convex pieces of parchment-like membrane, gathered into numerous fine plaits, and are lodged in cavities on the sides of the bodies behind the thorax. They are not played upon with sticks, of course, but by muscles or cords fastened to the inside of the drums. When these muscles contract and relax, which they do with great rapidity, the drum-heads are alternately tightened and loosened, recovering their natural convexity by their own elasticity. Our Cicada may, therefore, be called a drummer."

"But Mr. Mayfield," interrupted Harry, "a drum-head don't tighten and loosen in that way. You tighten it up, and keep it tight, or it wouldn't drum at all."

"Of course, Harry," I replied, "we can only speak in figures when we compare the sound-producing organs of insects to musical instruments of any sort. All I mean is that the principle upon which the Cicada's note is produced is like that upon which sounds are brought out of a drum-head. Let us see if this is not so. Here is a sheet of tin which I have laid upon the

table to illustrate my point. It is not flat, but is bent into little rolls and hollows. I put my finger upon one of the elevated parts, and push it down, and remove my finger, so. It makes a loud, rattling noise. I repeat the motion rapidly a number of times, and you hear a succession of these sounds."

"Certainly they are distinct enough, but they can hardly be called *musical*," remarked the Mistress, laughing, as the loud clatter of the tin sheet resounded through the room.

"True enough; but is a kettle-drum any more so?" queried Aunt Hannah.

"I am not so much concerned about the æsthetical part of my illustration," I replied, "as the practical. Now, Harry, observe, when the drumstick falls upon the tight drum-head, it pushes it down just as my finger did the tin sheet; when it is lifted the drum-head springs up again, and that motion produces a sound not unlike that which I have just made. As the skin out of which the drum-head is made is stretched over a hollow cylinder, or 'barrel,' the vibrations of the air are greatly increased, and so also is the intensity of the sound. Do you understand that, Harry?"

"I think I do, sir," said the boy.

"Very well; it is quite in this way that the Cicada's note is produced. These convex membranes or drums of which I spoke are the drum-heads. But where are the 'barrels' over which they are stretched? Here they are. There are certain cavities within the body of the insect which may be seen on raising two

large valves beneath the belly, and which are separated from each other by thin partitions having the transparency and brilliancy of thin and highly polished glass. In most of our species of Cicada the drums are not visible on the outside of the body, but are covered by convex triangular pieces on each side of the first ring behind the thorax, which must be cut away in order to expose them. Now, if we raise the large valves, of which I spoke, there is seen close to each side of the body the little opening like a pocket in which the drum is lodged, and from which the sound issues when the insect opens the valve."

"Sir," said Harry, "you have shown us the drum-head and the drum-barrel, but where are the drum-sticks?"

"You forget; I have already spoken of them. They are the muscles or cords fastened to the inside of the drums, by which the heads are made to rapidly tighten and loosen. Unfortunately, I cannot show you these without better optical aids than we have here; but you must take their existence on faith or authority, as one has to do very many things in Natural History. The effect of the rapid alternate tension and relaxation of these drum-stick muscles and the membrane attached to them, is the production of the rattling buzz, which constitutes the familiar music of the cicada. And now that I have given my illustration, I shall ask Harry to give one which he has prepared at my request."

Harry blushed and hesitated, but finally took from his pocket an instrument with which my own boyhood

had been quite familiar. It was a little hollow tube of tin, over which a stiff piece of writing-paper was stretched and securely fastened. This Harry called the "buzzer." Through two holes in the paper was drawn a horse-hair, which at the other end was looped around a stick.

Harry took his stand in the middle of the room, touched the tip of the stick to his lips, and then rapidly whirled the implement through the air. The hair straightened out, the buzzer revolved, the loop tightened upon and moved around the stick, and amidst the laughter and plaudits of our company; the room was filled with a shrill, quivering, rattling noise:

"*Cr-reek! Cr-r-eck! cryee-ee-ee-e-e-ick-i-i-ii-ii-ee-ee-eek!*"

The sound thus produced was an admirable imitation of the cicada's note, and Harry's illustration was warmly applauded as a great success.

"Now," said Abby, "you must explain for us the philosophy of Harry's toy. How does it make this noise?"

"The principle is a very simple one. The horse-hair loop rasps against the stick as it is twirled around, the vibrations thus produced are carried along the hair to the stiff paper, which acts as a sounding-board to them. The tube or little box serves as a resonator, to increase the intensity of the tone. The notes, of course, are varied according to the velocity of the 'buzzer.' The toy may be made with a spool, the hole through which is sufficient to make a good resonator."

The Doctor had followed Harry's movements with

FIG. 103.—THE MUSIC OF BOYHOOD, A REMINISCENCE: "WATCHING THE HOSTS OF INSECTS CREEP OUT OF THE GROUND."

unusual interest. There was a pleasant, very pleasant smile upon his lips, and as he gazed into the embers of the hickory-wood fire there was a far-away cast in the eyes. He drummed upon the table with his fingers in an abstracted way, and at last exclaimed:

"Well, well, well! I had dreamed myself quite into

boyhood once more. The old log schoolhouse seemed to be rising there out of the ashes, and I could fancy myself standing among the playmates and companions of three-score years ago—alas! few of them remain now in the flesh!—whirling my toy 'locust,' and watching the hosts of insects creep out of the ground and emerge from the cracked shells which we gathered in handfulls from the trees, among whose branches noisy males were rolling their rattling drums! (Fig. 103.) Sixty years! Has it been so long ago? How vividly this little toy's familiar music has revived the memories of those days. Ah!—But excuse me, friends, for obtruding these recollections upon you. Really, I was carried away for the moment!"

He bowed several times in a gentle and deprecating way toward the circle, but amid the radiance that glowed upon his face, I could see two round tears twinkling through his eyelids. Dear good man! Alas, he, too, since then, has joined the playmates of those early days in

> "The innumerable caravan which moves
> To that mysterious realm where each shall take
> His chamber in the silent halls of death."

CHAPTER XVII.

"SERMONS IN"—ANTS.

On Sunday morning we worshiped in the "Blue Church." Doctor Goodman preached to a little company of the country-folk a sermon whose character was well described by a plain old Scotchman whom I overheard as the congregation was retiring: "Ah, that was one o' the comfortin' an' helpfu' sort!"

I had observed, during one of my summers at Marple, that the Doctor delivered his sermons, which he read quite closely but with remarkable earnestness and force, from manuscripts of a uniform number of pages, bound up like a school copy-book.

"Why do I do this?" he said, laughingly, in answer to my question. "Well, the truth is, I find myself compelled to put a bridle upon my lips. As I grew older, I noticed that I was inclined to prolong my sermons to a wearisome length. I therefore took to reading; and in order to keep within due bounds I made trial of the exact number of pages required to occupy the half hour. I then had a lot of these "copy-books" made, each containing that trial number of pages. Now when I have filled my book I stop work, and go into my pulpit quite assured that I will not trespass

upon my people's patience. Isn't that a pretty good device to keep a garrulous old parson within bounds?"

The hearty laugh with which the Doctor put the question showed how much he enjoyed the trick by which he had flanked the infirmities of gathering years, and held the interest of his auditors. A wise winner of souls was he!

But on this occasion the "copy-book" was left at home, and in simple words, delivered with quiet earnestness and a tenderness that touched all and melted many hearts, he held up to the people the great love of the All-Father. The text was, "Yea, I have loved thee with an everlasting love." When it was announced, the Calvanists in the congregation nudged each other, and with significant nods of the head and brightened eyes intimated that they expected a sermon upon "Electing Love," and heartily approved it. The Arminians, on the other hand, for the congregation was a mixed one, bristled up, set their faces with a pugnacious cast, and looked at the preacher with the fixed, hard gaze of those who mean to hold fast their own opinions against all comers.

As the sermon advanced these countenances changed; lines of elation and approval, of combativeness and dissent alike faded out, and the faces upturned toward the pulpit wore a common look (varying with the points of the discourse) of interest, assent, hope, religious joy.

One might, perhaps, have found the Doctor's theological bent by slight logical soundings; but it did not so lie upon the surface as to mar the satisfaction of any

auditor. The Eternity and Infinity of Divine Love—that was his theme. Man pre-existant in the loving thought of God throughout the everlasting past; man surrounded by the loving care of God in the present; man throughout the everlasting future, immortal in the rest of God; man's Redeemer, the highest commendation of the divine love—these are great thoughts, but simply presented, with quaint and apt illustration, they were not beyond the conception of the humblest mill-hand in the meeting.

The morning sermon was a happy preparation for the afternoon service, which, as the Doctor announced, was especially for the young people, although adults were also invited. He well knew that grown-up folk enjoy and profit by such services quite as much as their juniors. They drink in greedily addresses made to the young which they would have resented highly if made to themselves. What a curious compound human nature is!

At three o'clock of the afternoon the approaches to the church were lively with little troops of children, whose bright dresses showed against the green meadows as they came across lots. Farmers came in their buggies, germantowns and farm-wagons, until the cozy horse-sheds in the rear of the edifice were full, and horses had to be unhooked and hitched to the wheels of vehicles halted here and there over the yard.

Many of these comers were casual attendants, having various places of worship scattered throughout the country-side, but had gathered to the "Doctor's appoint-

ment," as is the goodly fashion of our rural parts, without respect of religious preference. Even the Friends, who had held their morning worship in the old Springfield Meeting-house, sent a fair delegation, although some were still of too tender conscience to wait upon the preaching of a "hireling minister." Among these was Aunt Hannah; but it cost the good woman a sore struggle to stay at home, be it said to her credit. Penn Townes, however, was not prevented by such scruples from stopping his smart open buggy at the old farm-gate and driving Abby Bradford to the meeting.

The regular attendants at the Blue Church were the teachers and the children of the Sunday-school. The latter were gathered chiefly from the families of the operatives in a woolen-mill that stood in an adjacent valley, and a fine paper-mill that occupies a romantic site on the banks of Crum Creek. A few kind and Christian hearts had been moved with pity over these scattered sheep of the Good Shepherd, and had organized for them a Sabbath-school, which has been maintained, often under sore difficulties, for a number of years. A part of the good Doctor's missionary work was to look after this school, which, however, was strictly a "Union" school, without any denominational bias or connection whatever.

The building in which this assemblage was held is worthy of brief notice. It was erected by one of the numerous descendants of Jane Townes, and set apart forever to the worship of the Almighty without cost or let to any of whatever denomination, with one important

FIG. 104.—THE BLUE CHURCH.

exception. Just in front of the pulpit hangs a framed card on which the patron's wish is printed, with this proviso: that no one who denies the proper divinity of our Lord Jesus Christ or the doctrine of the Atonement shall ever be permitted to preach in the place. The house was built at the time when the conflict was at its height that divided the Society of Friends into the so-called "Orthodox" and "Hicksite" camps. The feelings awakened by that controversy are crystalized in this proviso, and the "Townes Free Church" is free only to orthodox preachers. However, as there are very few persons of a different religious bent in the whole country-side, the prohibition has not proved of much practical disadvantage.

The house is built of a blue limestone which, in spite of the ill-fitting coat of whitewash that now covers it, shows plainly enough the reason for its popular name, "The Blue Church." It is a plain rectangular edifice, with a pitched roof, without spire or belfry. There is a door at either gable, over one of which is placed a rude water-shed. A plain porch covers the front door, which is shaded by a horse-chestnut, upon whose lower branches hangs a hornet's nest.

On either side of the door is a marble tombstone. In the north tomb repose the ashes of the venerable builder of the church. A plain slab rests upon low marble walls, and bears the name, age, and following inscription: "Where he was born, there he lived and died. An honest man and a useful citizen." There is

added the familiar passage from Job: "I know that my Redeemer liveth."

A fine large willow tree stands in front, and over hangs this grave. The tomb on the opposite side is a slab raised upon six marble pillars, and bears the name of a favorite cousin of the patron. Those tombs serve as seats for the rustic congregation while waiting for the commencement of service, and tramps who camp of summer nights in the horse-sheds play cards upon them in the moonlight. The entrance to the church is from the Baltimore Pike by a large wooden gate hung in the stone wall that encloses two sides of the lot. One corner of the churchyard is devoted to burial purposes. Here stands another large weeping-willow, and tall bushes of osage orange and sumach overshadow the wall. Short mounds of buried children fill the space, though larger graves show where the "rude forefathers of the hamlet sleep." In the rank grass and among the vines that here creep over the ground and swathe the graves dwell undisturbed hosts of insects, especially crickets and grasshoppers. (Fig. 105.) Among these the great green grasshopper abounds one of the noisiest of our musical insects, and day and night alike his shrilling is heard among the graves, making this rural "God's-acre" a very garden of insect song.

The plain stone building is a pretty object, standing in its two-acre field, embowered among trees. Just across the meadow is a farm, once a country seat of an eminent president of the Pennsylvania Railroad. Adjoining that, the cupola of "Shady-bank," a fine

FIG. 105.—THE GRASSHOPPER'S DIRGE AMONG THE GRAVES.

country home, rises above the tops of a noble grove of trees.

Inside, the building is exceedingly plain. It is fashioned after the manner of a Quaker meeting-house, having a "gallery," or long rows of elevated seats along the middle, opposite the door. A pulpit is arranged at the central part of the gallery, beneath which is a chancel-like space, where stand a reed organ and a superintendent's desk. Comfortable sofa-benches, with reversible backs, are ranged in front and on either side of the pulpit. In front of the chancel stands a large cannon

stove, whose long pipe penetrates the ceiling. The walls are unadorned, and the whole interior is plain enough to suit the severest taste.

It was well ornamented, however, on that day, for as we entered, bright faces were turned toward us from every seat and aisle; even the door spaces were crowded, and anxious eyes peered in from groups that stood in the churchyard outside. In the "gallery," at one side, stood a tall easel, on which was placed a package of large white card-boards.

This addition to the usual furniture of the place had excited much curiosity among the audience—young and old. Indeed, the curiosity had begun earlier in the day, among the family at the Old Farm; for, as Hugh lifted the mysterious parcels into the farm-wagon, among the chairs on which his family were seated, there were many wonderings over them.

"W'at on yarth is de Doctor gwain to do wid dem sings?" asked Dan, who was perched on the driver's seat, and faced quite about to watch Hugh's proceedings. "Whew! dat now," as the heavy packet of card-board was lifted in, "'pears 's dough it mought be Moses' Table ob de Law. But as fer dat," looking at the easel, "I can't make nuffin out on 't. Dat 's w'at de Misstis had her picter ob de Wirgin Mary and de baby Jesus on—her 'Donna, she calls hit. But Massa sakes! de ole Doctor 's down on 'Donnas an images an all sech wanities in de house ob de Lord! He haint gwain to fall down befo' no sech golden calf, is he?"

Abby, too, was on the *qui vive;* but if the Mistress

guessed the Doctor's purpose, she kept her own counsel, and put off the inquisitive Schoolma'am with the remark that neither the Doctor nor her husband had taken her into confidence.

The dominie's little secret was soon disclosed. When several songs had been sung by the children, he rose to make his address. After a few sentences of kindly commendation, he said:

"And now, my dear young friends, I have prepared for you an especial treat. You have often heard my voice telling you of the goodness and wisdom of our God. I shall let another speak for me to-day—a dear friend, whom, I am sure, you will be glad to hear."

In the brief pause that followed many eyes roved up and down the front benches in quest of some known minister or public speaker who might undertake such a duty. It was very plain upon the faces before me that the matter was yet wholly in doubt.

"Who could it be?" whispered a farmer's wife at my side, as she plucked a clove-seed from a small store stowed in the finger of a glove, and bit off the end.

No one ventured an opinion, and the Doctor continued: "One of the greatest of English poets has said that we may find

> "'——books in the running brooks,
> Sermons in stones and good in everything.'

"I believe that thoroughly. The Bible is a book of Nature. The inspired writers, through whom the Holy Spirit spoke, were in full sympathy with the world of

created things around them. Birds, beasts, flowers, trees, mountains, brooks, stars, moon and sun, clouds, rain and snow, waving crops of gathered grain, all were seen by them with interest and pleasure, and made to speak for them some truth or lesson of daily life. Well, if all these things have in them a sacred thought for us, shouldn't we try to find out what that thought is? I have often taught you out of this Revelation of Inspiration"—and he laid his hand upon the Bible; "I have asked another to teach you this afternoon out of the Revelation of Creation. If it be true that we may find 'sermons in stones,' I think it is equally sure that we may find sermons in insects. I have therefore great pleasure in introducing to you my very dear friend, Mr. Fielding Mayfield."

There! the Doctor's secret was out. Yes, I had at last consented, after much hesitation, to talk to the young people about some of the Bible insects. All other difficulties being removed, the Doctor had overcome my scruples as a layman against seeming to conduct a religious service by declaring that he was to be and would be the officiating clergyman, and that I surely might, at his appointment and request, address the children. It was my own suggestion that the matter be kept secret, for I wished thus to avoid the attendance of such curious people as might have been attracted simply by the unusual nature of the address.

The announcement was followed by a buzz of whispered wonder and expectation. As I sat opposite some of the members of the old-farm family, I could note

FIG. 106.—AGRICULTURAL ANTS ENGAGED IN CUTTING GRASS.

the effect upon them. The Mistress flushed, turned pale, then flushed again, and I caught the light of a tear twinkling in her eye ere she dropped her face upon her fan. Abby started as though struck, looked at me, then at the Mistress on one side, then at Penn Townes on the other, clasped her hands—I thought at first she meant to clap them—drew her lips under her teeth as though to suppress an audible utterance of surprise, and at last a radiant smile broke over her glowing face. Old Dan sat on the corner of a bench before the stove, bowed over on his arms and rocking his body to and fro. As the Doctor spoke my name he sat bolt upright, dropped his broad palms with a loud smack upon his knees, rolled his eyes to their full rotundity, pursed up his thick lips, and blew through them till he fairly whistled. As I rose to go into the gallery I heard him say in a deep sotto voce:

"Bress de Lor'! Mars Mayfiel'! Well, dat takes de cakes!"

THE LECTURE.

"I am sure you are all surprised," I began, "to hear my name spoken as one who shall address you to-day. You cannot be more surprised than I was when our good friend the Doctor first asked me to occupy this place. I have never before addressed a religious meeting of any kind. Perhaps I speak this to my shame; but my duty has never seemed to lie in that direction, and I mention it now simply to say that the whole responsibility of my appearance here on this holy day as

an instructor in sacred truths must be placed upon this good man who is to-day our bishop.

"Some of you, perhaps, have heard that many years ago I gave a large part of my time to the study of insects—those little creatures who are popularly known among us as 'bugs.' I am sorry that people do not speak more correctly in this matter. There are indeed some insects who are properly called by that name; but all insects are not bugs, indeed a very small proportion of them belong to that group. These favorite studies of mine have led Dr. Goodman to ask me to speak about the insects of the Bible.

"Among those which the Good Book mentions is the ant. I have known city children who never saw an ant, or at least had no notion at all what that insect looks like—in fact, couldn't tell an ant from a grasshopper. But among these country children before me I am sure that there is not a single one who doesn't know just how an ant looks. However, I will venture to show you a picture of one." (Fig. 106.)

I turned the outer card upon the easel, and amid many half-suppressed "Oh's!" exhibited a colored figure. This, by-the-way, was one of a series of drawings which I had prepared at one time for a course of lectures. They had received a resurrection from the store room of my city business place where they had long been buried amid sundry rubbish, and were forwarded to me by express when the Doctor's request gave occasion for their use.

"These figures show two ants known as the Agricul-

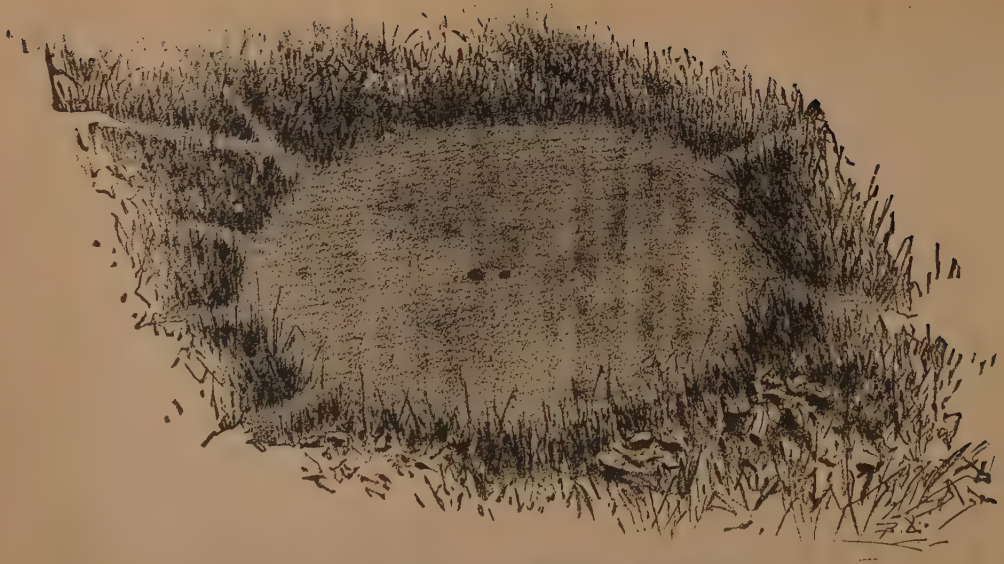

FIG. 107.—FRONT YARD AND ROADS OF ANTS' NEST.

tural Ant of Texas, oftener called by the people of that State the 'Stinging Ant,' because its sting is as severe as a hornet's. They are cutting down a blade of grass. One has laid his sharp jaws at the very root of the plant, while the other appears to be swaying down the leaf in order to increase the effect of the cut. If this is done on purpose, as it seemed to me when I drew it, the ants are working on the same principle that you do when in early autumn you go out with a hatchet to clear away the rank growth of vines along the roadside and fences.

"The next picture will show you the object which these little workers have in view. (Fig. 107.) They are making a clearing, as I have seen pioneers do in Western States when they entered the great forest and began to hew down the trees. Many years ago all this beautiful country around us was covered with a dense forest, and when our forefathers came they chopped away the trees and made clearings for their houses and fields. Now, our Agricultural Ants like to have a clear space or yard around their doors, and here they are cutting down the "trees," as these grass stalks must seem to them. You notice that these clearings differ in shape from our yards and fields, for they are circles or elipses, and are always made as you see them here. It is surprising to note what vigor the little pioneers have in keeping their yards clean. The weeds and grasses grow very rank in the rich soil and warm sun of Texas, and sometimes when pushing my way through them I have come across these circular clearings surrounded on all

FIG. 108.—ANT CLEARING IN A WEED FOREST.

sides by the weedy jungle, and not a scrap of vegetation of any kind upon them. Here is one of these jungle-nests. (Fig. 108.)

"The door or gate of the nest is in the center of the yard. It is a single, or sometimes a double, opening, which leads down into the ground, where are a series of rooms and galleries that I shall presently describe. Long roads, usually three or four in number, and occasionally as many as seven, lead from the yard into the surrounding grass. They vary in length from forty feet or less to three hundred, and are kept smooth and clean. Indeed, our farmers would do well to take pattern after these wise little fellows in the matter of road-building and repairing, as well as in other things. You see these roads in the pictures, gradually narrowing as they run out into the grass. These are not the only ants that have the habit of road-building. We have ants in our own State who have great skill in that line of public industry; and here is a pretty undergrade highway, made at Rockland, in Fairmount Park, by a large colony of ants dwelling there. (Fig. 109.) You see how daintily the roads are bowered by avenues of grass, moss, and wild-flowers. Having told you this much, I will now show you what all this has to do with our Sabbath lessons. How many of you have Bibles?"

The answer to this question quite startled me. From every part of the room—to the right and left of me, in front of the desk, and even from the chancel-space where the children were crowded directly beneath my

FIG. 109.— UNDERGRADE ANT ROAD IN FAIRMOUNT PARK.

face—more than a hundred hands shot up, and as many Bibles of various sizes and styles were held aloft. I suppose my surprise was shown upon my face; the audience were infected by the speaker's attitude, and looked on silently at the strange scene. The children's faces were wreathed with smiles; the superintendent looked up from his seat with a well-pleased countenance, and broke the stillness with the explanation:

"We have a 'show of Bibles' every Sunday, sir. It is one of our ways of teaching the children to own and use their own Bibles."

"Many thanks," I said, "for this beautiful lesson. It is a new sight to me, and came as a great surprise. I never thought to have such an answer to my question. I shall not need to ask this school again, how many have Bibles? Now let us see what these Bibles have to say about ants?

"Turn to the sixth chapter of Proverbs."

There was a rustling of leaves, like the moving of wind through the tree-tops, as the young hands turned over the pages of the Sacred Book. The sound gradually died away, as one after another the children found the place, until all was still.

"Now, please, read together the 6th, 7th and 8th verses. The Doctor will lead you."

The old clergyman arose, and the scholars, well used to reading in concert, read with him, as with one voice, the following words:

"Go to the ant, thou sluggard; consider her ways, and be wise: which, having no guide, overseer, or

ruler, provideth her meat in the summer, and gathereth her food in the harvest."

"Very good; turn again to the thirtieth chapter of Proverbs, and read the 24th and 25th verses."

The sound of fluttering leaves once more filled the house, and then the school read these words:

"There be four things which are little upon the earth, but they are exceeding wise. The ants are a people not strong, yet they prepare their meat in summer."

"You thus see," I resumed, "that the wise man who wrote the Proverbs believed that the ants of Palestine had a habit of storing up seeds of grain during the harvest time. No one appears to have disputed this until about one hundred years ago, when an English naturalist, Mr. Gould, who was also a clergyman, discovered that the ants of his country were not harvesters. Other naturalists came to the same conclusion about the ants of other parts of Europe, and by-and-by it came to be the prevailing opinion among scientific people that no harvesting-ants existed. They said that Solomon, Virgil, Homer, and all the ancient writers who spoke of such insects, were in error; in fact had mistaken the eggs or cocoons that ants are often seen carrying, for grains of wheat, which they somewhat resemble."

"Well, in the course of time, a gentleman living in Texas wrote up to our Philadelphia Academy of Sciences that there was a harvesting-ant in that State! The account was not generally believed among naturalists,

and I resolved to go down to that country and see for myself. I have already told you something of what I saw, and I will now go on with my story.

"I pitched my camp on the hills of Barton Creek, beyond Austin, the State capital, and sat down to watch beside one of these nests which I have shown you. Presently I saw an ant come up out of the gate, carrying in its jaws something which it dragged across the yard, and dumped upon a heap of similar objects, lying in the grass at one side. I took up some of these, and found them to be the husks of a sort of grass known as ant-rice, or needle-grass. That was proof number one.

"Next, I noticed that the ant-workers were continually running along the roads, across the yard, and disappearing through the gate with some kind of seed, which they bore in their stout mandibles or jaws. I tapped several of these porters on the back, in order to make them drop their burdens, which I then examined, and found to be whole seeds of the ant-rice. That was proof number two—the ants were actually carrying the grain into their nests.

"Once more, I saw that workers were continually leaving the gate and traveling along the roads outward toward the grass. I stooped down upon hands and knees to follow one of these. Off it went at a lively pace, further and further, until the roadway began to narrow into a thin line, when it darted off to one side, into the thick grass. It kept me on close watch to keep the busy insect in sight. It twisted back and forth, around

and around among the grass stalks, now and then stopping to put its jaws upon objects lying upon the ground which I soon discovered to be fallen seeds. At last the fastidious creature found one that suited her. She turned this way and that, until it appeared to be balanced to her mind, then wheeled about, and started toward home.

"What a time she had with that seed! All sorts of little obstacles lay in her path—little to us, that is, but great to her. There were blades of grass bent down to the ground; there were sticks, stocks and stones lying in the path; there were close-growing tufts of grass like small thickets in the way. These were to be flanked, or climbed over, or pushed through, and right nobly the little carrier did her task. Now she went straight up and forward; now she backed to this side, dragging her burden along; now she sidled around the obstacle; now she plunged into a hole, and after a moment's rallying bravely mounted the wall and went on her way. So she journeyed, winding her laborious path through the grass-forest of her harvest field until she reached the road. Then, conscious that her way was clear, she broke into a smart trot, and made straight headway for her nest, and soon disappeared within the gate. The burden which she bore was a seed of ant-rice, and that was proof number three that this ant, at least, as Solomon said, 'provideth her meat in the summer, and gathereth her food in the harvest.'

"My next work was to explore the inside of the nest,

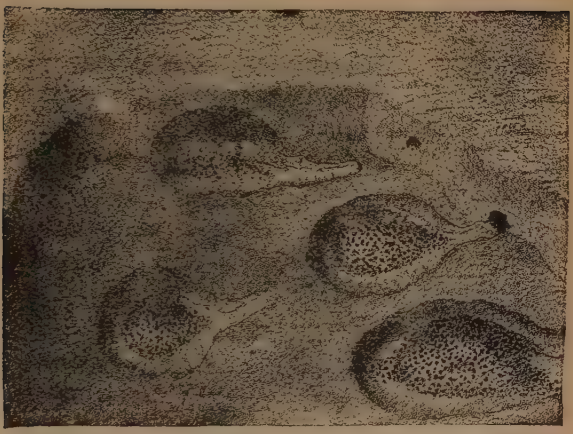

FIG. 110.—GRANARIES SHOWING SEEDS AND STORES.

or formicary, as it is called. This was no slight task, for several reasons. The yards are very wide, some of them fifteen feet in diameter, more than half as wide as this house. They are made in a stiff, tough earth which is difficult to dig; moreover, the ants carry a powerful weapon in the shape of a sting, which they ply with great fierceness when their nests are disturbed; and I could not blame them for that, for there are few creatures on earth who will not defend their own home. I had, therefore, to hire a little army of men to help in the digging and to fight off the angry insects that swarmed forth to attack us. I was severely stung a number of times, but persevered until I had satisfied myself that quantities of seeds were stored within the formicary. Some of those near the top were yet cov-

FIG. 111.—MOUND NEST OF OCCIDENT-ANT.

ered with husks, others further down were shelled, so that I could account for the heaps of husks which were placed around the margin of the yard.

"The seeds were stored in small caverns or pockets several inches long and about an inch high. Some were circular, others semi-circular in shape. Here is a view of a group of these granaries (Fig. 110.) You are looking down from the yard into them, remember, and of course the roof has been omitted from the picture to show you the stores of grain garnered within. Here then was proof number four—the ants do store away the ant-rice and other seeds, for I found more than one kind within their little store-houses and barns.

"But what do they do with these seeds? Are they really provided as 'meat' and gathered for 'food,' as the inspired writer says? I had no doubt about that myself; but I wanted to prove it beyond question. Of course I could not creep down into the nest and live there long enough to see the insects at their meals; nor would they come out-of-doors and have an emmet picnic in the open just to show me how they did. What, then, should I do? I did this: I had a large number of the ants shipped to me from Texas, built for them small artificial formicaries in my library, and kept them during an entire winter under observation. I saw many interesting and cunning habits, which I have not time to relate to you, but among these was their food-habit. I observed that they did eat the seeds which I had taken from their nests, as well as other grains, such as oats. They lapped up the oily substance

FIG. 112.—INTERIOR PLAN OF STORE-ROOMS AND GALLERIES.

from the nut-like seeds, just as a cat does milk, and licked off the starchy grains, as I have seen children lick a candy-stick. Thus was added the last link to the chain of proof that our Texas Agriculturals are real harvesting-ants.

"These are not the only harvesters. It was not hard to discover that two species with the same habit live in the Holy Land, where Solomon dwelt and wrote, and also in countries where Homer and Virgil lived, who also had told about the harvesting-ants. You may be very sure,

FIG. 113.—OPEN GRANARY OF HARVESTING-ANT.

FIG. 114.—OCCIDENT-ANT GATHERING SUNFLOWER SEED.

therefore, that these ancient writers made no mistake, and that the naturalists who voted them in error were wrong themselves.

"We have other harvesting-ants in our own land. Two of the most common objects that attract the eye of a traveler upon the Great American Plains are the villages of the Prairie-dogs and the cone-shaped mounds of the Occident-ant. Here is one of these (Fig. 111.) They are covered with gravel, which the ants bring up from beneath, having dug them out in making their granaries and boring out pipe-like roads or galleries that unite them. The granaries are ranged in stories one above another, and I traced them as far as eight feet beneath the surface. This figure (Fig. 112) shows an interior plan of one of these nests, as it was seen

FIG. 115.—GRANARIES OF THE PENNSYLVANIA HARVESTER.

after one side had been dug away, and this (Fig. 113) is one of the granaries cut out of the soil in which it was dug. These letters, R, R, (Fig. 112) show store-rooms or granaries in which quantities of seeds were placed, and these G, G, are galleries that connect them. I saw some of these Occident Ants gathering wild sunflower seeds in the Garden-of-the-gods, and our next picture shows her mounted upon the flower and tugging away at a seed with all her might. (Fig. 114.)

"Indeed, we need not go to Texas or Colorado or Florida to find American harvesting-ants. Right here in our own neighborhood, in the field in which this church stands, in the orchard-walk at Shadybank over the way, and in various places around the Old Farm where I live, there is a little black ant, the Pennsylvania Harvester (*Pheidole Pennsylvanicus*), who harvests seed, and here is a drawing of two of its granaries (Fig. 115.)

One of the worker-castes is a funny-looking creature, having a very large head. It is known as the 'Soldier,' while the other forms are called 'workers.'

THE LESSONS.

"And now, my children, having told you something about that habit which the good Book refers to, let me point you to the lessons which it is intended to teach. The first is a lesson of Honest Industry. Turn once more to Proverbs, Chapter xxx, and take up the Scripture at the verse where we stopped before—the 9th. Read, now, the 9th, 10th and 11th verses:

"'How long wilt thou sleep, O sluggard? When wilt thou arise out of thy sleep? Yet a little sleep, a little slumber, a little folding of the hands to sleep! So shall thy poverty come as one that traveleth, and thy want as an armed man."

"That is the lesson. If you love idleness and sleep, if you grow up to be sluggards, poverty and want will sweep down fast upon you like a swift traveler, and will conquer and destroy you like an enemy in arms. It is the hand of the diligent that shall wax rich. Learn to work honestly and lovingly, not simply to get your task done and pocket the pay for it, but as one who loves his business, and is determined to do his whole duty to his employer. Drive every nail, spin every thread, turn every furrow, sweep every room, dust every chair, wash every dish as in the sight of One who sees the slightest act and will try all your work. Quaint George Herbert has well sung:

> Who sweeps a room as for Thy laws
> Makes that and the action fine."

The lazy person is always an unfortunate person, usually an unhappy and often a wicked one. The poet Spencer, in his 'Faerie Queene,' has well called 'Sluggish Idlenesse the Nourse of Sinne.'

"There is another lesson which I may venture to refer to, though I must ask the religious leader at my side to enlarge upon it. It is a lesson of forethought of that Future which lies before all souls. Old age, misfortune, and death hasten upon man like the Winter of the year. Would you lay up in Heaven a store of good deeds—a treasure which cannot be stolen and will not decay? Begin now! 'Remember now thy Creator in the days of thy youth, ere the evil days come.' This is the harvest time for you—for us all. Use it to form a character that shall stand the test of an Eternal Judge, and to do deeds of goodness, righteousness, purity, truthfulness, honor, which shall bless not only yourselves but the generation in which you live. A recent author thus begins his book: 'Some things God gives often, some he gives but once. The seasons come and go and the flowers change with the months, but youth comes twice to none.' If the temptation should come to you to defer to another, and yet further, and yet more distant day, the duty of laying up store of spiritual wealth—noble character, kindly deeds and immortal Hope through the Saviour of all, then remember the teaching of our humble insect friends. 'Go to

the ant, thou sluggard! Consider her ways, and be wise.'"

The Doctor followed with apt and tender words, the children sang a familiar refrain, and after prayer the meeting was dismissed.

Was my address a success? I wondered and greatly feared.

But the Doctor took my hand, and pressing it warmly, looked into my face with his honest, kindly eyes, and said: "Well done! you have taught us all to-day to 'look from Nature up to Nature's God.'"

When we had reached home the Mistress came to me and said: "It was a sweet surprise. I was never happier than this day when I saw my husband standing with that holy man in the good work of helping those poor children to attain a happier future both here and hereafter."

Thus I was comforted.

CHAPTER XVIII.

SEVENTEEN YEARS UNDER GROUND.

WE were made happy by seeing the sleek sides of Dr. Goodman's old horse, "Bob," stop before our gate on the Saturday afternoon preceding our next Conversation. The dominie had promised to join us, if possible, in our concluding study of the natural history of the Cicada, and to contribute some notes upon its mythology and ethnology. In consideration of this, our Conversation was arranged to begin a little earlier, so that I might return with the Doctor to the Manse that night, and remain with him over the Sunday. Aunt Hannah and Penn were promptly in their places, so that our circle was complete.

"The duration of life in many winged insects," I began, "is comparatively short, seldom exceeding two or three weeks in extent, and in many is limited to the same number of days, or hours. You need not be surprised, therefore, if I tell you that the Cicada, or Harvest-fly, lives only a few weeks after its transformation."

"It always seemed very strange to me," said Aunt Hannah, "and sad, too, that such beautiful and perfect creatures should be doomed to so brief a life. I remem-

ber to have had this thought when I read in an agricultural paper some time ago of the tribes of ephemeral insects which are born, live merrily, grow old, and die within the compass of twenty-four hours. That seemed to me a great waste of Nature's noble gifts, and I so said in the presence of one of our ministers. I was much surprised when at the meeting next First Day, she was moved to refer to this in a beautiful address upon the fleeting nature of our life, and the vanity of making so much of it, instead of preparing for a higher and nobler state of being."

"I am not surprised, Aunt Hannah," I answered, "that you should have fallen into so common an error, and your minister was not the first to use the same as a text for moral lessons. The great Dr. Franklin once published an essay, full of very instructive philosophy, which he put as an address into the mouth of an 'Ancient Ephemera,' that had lived to the extreme old age of four hundred and twenty minutes! Like your good Friend's remarks in the meeting, his moral reflections are admirable, but his entomology is defective."

There are, indeed, several flies, known as May-flies, or Ephemera that live but a very short time, and a few of them only for ten or twelve hours, *in the winged state.* But the larvæ of these very same flies have lived in the water for nearly a year before they left their native element and became denizens of the air. Of course they are insects quite as truly when in the larval as when in the imago state, and there is no

basis of fact in the metaphor which measures their life by a few hours."

"Thee amazes me, friend Mayfield!" exclaimed Aunt Hannah. "Thee is proving a veritable iconoclast with thy entomology. First thee has taken out of our mouths our life-long associations with the locusts, and now thee destroys utterly our notions about the Ephemera. I am glad thee has spared the good Friend's lesson, at any rate."

"The destruction of ancient errors is not usually a grateful task, Aunt Hannah, especially when they are well imbedded in the minds of people. They become, by-and-by, as sacred as truth, and any disturbance of them pains and irritates like the return of healthy circulation to a benumbed or frozen limb. However, as there is no special interest or principle attacked in this effort to bring in a true entomological nomenclature, I hope that my friends will be sparing of their indignation.

"What I began to say is this—the Cicadas enjoy but a few days of life in the winged state, but in the case of the periodical species they are largely compensated by a remarkable length of life in their wingless and grub-like form. Seventeen years the one species, thirteen years the other, live underneath the ground. I can think of no parallel case within the whole range of natural history. In view of this amazing longevity one may well be sparing of sympathy with the winged musicians over the brevity of their days.

"Let us trace their history from the deposit of the

eggs until the emerging of the winged form. The abdominal part of the female Cicada, as you see, is conical, and on the under side is a longitudinal channel for the reception of the piercer. This organ is further protected by four short grooved pieces fixed in the sides of the channel. The piercer itself consists of three parts in close contact with each other—namely, two outer ones, grooved on the inside and enlarged at the tips, which externally are beset with small teeth like a saw; and a central spear-pointed borer which plays between the other two. Thus this instrument has the power and does the work both of an awl and a double-edged saw, or rather of two key-hole saws cutting opposite to each other.

"When the time has come for the female to lay her eggs she selects a position near the tip of a twig. The seventeen year Cicada has a great preference for the oak, next to that probably the hickory, but oviposits in almost every kind of deciduous tree, and even in herbaceous plants, and occasionally evergreens. I have known pruinosa to oviposit in a stem of golden-rod.

"Her method is this: She places her head upward, that is, toward the terminal part of the twig, and with her piercer saws a longitudinal furrow in the wood. Then, with her ovipositor, she forces the eggs a little distance down below the external opening. The eggs are of a pearl white color, one-twelfth of an inch long, and taper to an obtuse point at each end. When in the act of cutting she clasps the branch on both sides with her legs, and then, bending down the piercer at

an angle of about forty-five degrees, repeatedly thrusts it obliquely into the bark and wood in the direction of the fibres. At the same time she puts in motion the lateral saws, and in this way detaches little splinters of the wood at one perforation. The hole is bored obliquely to the pith, and is gradually enlarged by a repetition of the same operation, until a fissure is formed large enough to receive from ten to twenty eggs. The side-pieces of the piercer serve as a groove to convey the eggs into the nest, where they are deposited in pairs, side by side, but separated from each other by a portion of woody fibre, and they are implanted into the limb somewhat obliquely, so that one end points upwards. When two eggs have been thus placed, the insect withdraws the piercer for a moment, and then inserts it again and drops two more eggs in a line with the first, and repeats the operation until she has filled the fissure from one end to another. Then she removes to a little distance and begins to make another nest." (Fig. 116.)

"How long does it take her to do this?" asked Penn.

"She is about fifteen minutes in preparing a single nest and filling it with eggs."

"How many of these egg-nests does she have?"

"It is not unusual for her to make fifteen or twenty fissures in the same limb; and one observer counted fifty nests extending along in a line, each containing fifteen or twenty eggs in two rows, and all of them apparently the work of one insect. After one limb is thus sufficiently stocked, the Cicada goes to another,

FIG. 116.—EGG-NESTS OF MOTHER CICADA.

and passes from limb to limb, and from tree to tree, till her store of four or five hundred eggs is exhausted. At length she becomes so weak by her incessant labors to provide for a succession of her kind, that she falters and falls in attempting to fly, and soon dies."

"Poor thing!" exclaimed the Mistress.

"Well, I say that it's a mighty lucky thing," Hugh remarked, "that so many of them twigs do wither and fall, and cause the eggs to die inside uv 'em. I reckon ther wouldn't be twigs enough to accommodate the risin' generations ef all them eggs hatched out."

"Harris says that after oviposition the female saws the branch partly off below the eggs, so that the wind may twist off the tip end containing the eggs and let it fall to the ground. Certainly many of the punctured twigs do break off and die, and in years of invasion the oak forests often have a gloomy and disheveled appearance from the number of branch-tips partly twisted off, and hanging with their dead leaves ready to fall. But it is doubtful if this is the result of a set purpose on the part of the mother Cicada, for a great majority of the incised twigs remain green and recover from their wounds. Indeed, it is probable that the eggs seldom hatch in those twigs which break off and become dry, and that the moisture of the living branch is necessary to the life and development of the egg. In the healing of the punctured parts of the limb a knot usually forms over each puncture."

"Doctor," said Abby, who had been examining the little bundle of twigs by which I had illustrated my

descriptions, "can you tell us what such destructive creatures were made for?"

"That is a question, I fancy, that falls within the province of the naturalist rather than the theologian," replied the Doctor, with a smile, wisely declining to enter into a problem of that nature.

But Aunt Hannah was not quite satisfied with that view of the matter, and suggested her own opinion by a series of questions: "Does thee know, friend Abby, why the ten plagues of Egypt were sent upon that land? or why the palmer-worm and the locust and the canker-worm and the caterpillar were sent upon Israel of old? Does not the prophet Joel suggest an answer when he says, "For the meat offering and the drink offering is withholden from the house of your Lord?"

The Doctor, who was not proof against this challenge, removed the spectacles from his eyes, and with a little preparatory "ahem!" turned to answer Aunt Hannah. Fortunately we were brought back from this theological digression and saved the impending discussion by a bit of hard fact which Hugh Bond interjected.

"As to them loc—beg y 'r pardon, them Harvest-flies, bein' destructive creeters, I never jes' see it, at all. Some folks allers make a poweful fuss over 'em w'en they come, and talk about the devourin' up uv every green thing, an' so forth. But my exper'ence is that ther bark 's wuss 'n ther bite.

"Now, I never seed any leaves or other green things eat up by locusts uv that sort. They does cut off a power o' young shoots an' sich, an' sometimes, w'en

they lights on a young fruit tree or saplin' they kills *hit*. But it don't do much harm in ordinar' fur to trim off the outer twigs uv trees. The trees make wood ag'in, an er not much the wuss fur wear. Ther 's a nation sight o' buzzin', an' ez Mr. Mayfield says, the woods does hev a sort o' rag-tag look, but it 's more in sight an' soun' than in solid harm, I 'm a thinkin'. In fac', ther 's a good 'eal more noise 'n execution in an army of harvest-flies, jes' like an ole-fashioned militia trainin' sham battle."

"That is very true," I said, "and I 'm much obliged to you, Hugh, for saving me the trouble of saying it. So you see, Miss Abby, that whatever general principle may lie beyond the problem that you started, it has no basis of facts to rest upon in the case of the Cicada. It is chiefly an example of an *un*-scientific use of the imagination, excited by that old and false name 'locusts.' Shakespeare has said that 'a rose by any other name would smell as sweet;' but there is a great deal more in a name than the poet seems to have thought. To quote the language of one of my entomological friends, suppose that roses were popularly called by the name of that well-known plant that spreads its broad leaves along the wooded parts of our Run—the 'skunk-cabbage'—what lover would dare to present to his mistress a bouquet composed of flowers bearing such an unsavory appellation? Or what lady, if she had such a bouquet actually presented to her, would trust her nostrils within a foot of it? Now, because we in America have chosen to call what are, properly speaking, 'Cica-

das,' by the ominous name of 'locusts,' people have thoughtlessly jumped at the conclusion that they must have the same voracious appetite as the 'locusts,' whose dreadfully destructive habits are so well described in Holy Scripture. However, this is aside from our natural history, to which we had better return.

"The eggs of the harvest-fly hatch in about six weeks after being deposited. The young insect when it bursts the shell is one-sixteenth of an inch long. In form it is somewhat grub-like, being longer in proportion than the parent insect. It is furnished with six legs, the first pair of which are very large, shaped almost like lobster-claws, and armed with strong spines beneath. On the shoulders are little prominences in the place of wings, and under the breast is a long beak for suction. The little creatures, when liberated from the shell or fine membrane which envelopes them after leaving the eggs, are very lively, and their movements are as sprightly as ants. Now follows a very interesting act of instinct. There the wee bodies are, far up at the top of the tree; but Nature has decreed them a life under ground. How do they get there?"

"W'y crawl down the tree," exclaimed Harry.

"No; that would, indeed, seem an easy way. But many perils might lurk in that winding path along the twigs, branches, and trunk. Nature has provided a better way. The mother Cicada has fortunately located her egg-nests near the tips of the outer limbs. And now, moved by a law which none of us can presume to comprehend, the young insects run to the side

of the twig and deliberately loosen their hold. Their specific gravity is so small that they fall through the air as softly as a feather. On reaching the ground they immediately bury themselves in the soil, burrowing by means of their broad and strong fore-feet, which, like those of the mole, are admirably adapted for digging." (Fig. 117.)

"This is wonderful!" exclaimed Aunt Hannah, laying down her knitting work. "Who would have thought to find such wisdom in so insignificant a creature?"

"Wonderful, indeed!" added the Mistress, and Abby echoed the note.

"But," queried the Doctor, "is it quite accurate to think of such behaviour as you describe as the result of wisdom in the young Cicadas? Doesn't this look like a case of fore-ordination in Nature, which requires one to postulate an Outside and Infinite Wisdom?"

"Let me read you," I responded, taking a volume from the table, "what the eminent naturalist, Dr. Harris, says, an author to whom I am indebted for much of the information here given. This is what he writes on this point: 'The instinct which impels them [the young Cicadas] thus fearlessly to precipitate themselves from the trees, from heights of which they can have formed no conception, without any experience or knowledge of the results of their adventurous leap, is still more remarkable than that which carries a gosling to the water as soon as it is hatched. In those actions that are the result of foresight, of memory, or of experience, animals are controlled by their own reason;

FIG. 117.—A LEAP FOR LIFE—THE CICADA UNDERGROUND.

as, in those to which they are led by the use of their ordinary senses, or by the indulgence of their common appetites, they may be said to be governed by the laws of their organization. But, in such as arise from special and extraordinary instincts, we see the most striking proofs of that Creative Wisdom which has implanted in them an unerring guide, where reason, the senses and the appetites would fail to direct them. The manner of the young Cicada's descent, so different from that of other insects, and seeming to require a special instinct to that end, would be considered incredible, perhaps, if it had not been ascertained and repeatedly confirmed by persons who have witnessed the proceeding.' And now," laying the book down, "let us go on with our history."

"During their descent into the earth, the Cicadas seem to follow the roots of plants. They are found attached to those which are most tender and succulent, which they perforate with their beaks, thus imbibing the vegetable juices, which constitute their sole nourishment." (See Fig. 117.)

"Is not this an injury to the trees?" asked Penn.

"Doubtless it often is; and I am disposed to believe that the chief injury done by the Harvest-fly is in this stage and manner. Indeed, an examination of the roots of a decaying fruit-tree has shown as the cause of disease a host of young Cicadas clinging to the roots with their beaks piercing the bark so deep and firmly as to keep them hanging for half an hour after removal from the earth."

"How far down do the Cicadas go?" asked Penn. "I have heard said that they burrow to an immense distance—ten or twelve feet from the surface."

"The question is fairly answered by the fact that the insects must live upon roots, which rarely descend very deeply. Our common annual Cicada, Pruinosa, of course lives in this condition for only a twelvemonth; but the young Septemdecim spend seventeen years in these dens and caves of the earth."

"What in the world do they do all that time?" asked Abby.

"A hard question," I replied, "and one must frame an answer as much by fancy as by facts. At least we may say that they burrow back and forth amid the maze of roots, and drink long and deep from the streams of savory sap, which they tap with their beaks. They thrive and grow in size. They take no end of sleep. Doubtless they greet each other in their silent way and pass who knows what communications? in the mysterious language of the mute children of the insect world. Maybe they peep and mouse into the tunnels and caves of worms, snails, and countless other creatures who share with them these Plutonic abodes; and perhaps vary the monotony of life, like civilized man, by wars of offense and defense. Shall I give further guess?"

"No, no!" that is quite enough," Abby laughingly rejoined, "to give one a fit of the blues at the very thought. I have often had my sympathies profoundly moved over the dreary fate of my fellow-creatures who spend their life

'Down in a coal mine underneath the ground,
Digging dusky diamonds all the year round.'

"But here is a destiny whose intolerable dreariness, even for a young bug, passes imagination. It paralyzes one's pity by its very magnitude. Dear, dear, what a monotonous fate!"

"No doubt, Miss Abby, your sympathy would be quite wasted upon our Cicada pupæ, who are enough like many of our own species to find a paradise in the most monotonous round of unthinking and inactive existence. As the years roll on, the four small, scale-like prominences on the Cicada's backs, which represent and actually contain their future wings, begin to swell. The long period of pubation is nearly done. Indeed life, at last, is nearly over, and it is to end in a brief glory of sunlight, wings, love and music. There is a strange stir in the thin blood of the insects that bids them mount upward. They cut their way through the soil by cylindrical passages, often very circuitous, the sides of which are firmly cemented and varnished so as to be waterproof. These burrows are about five-eighths of an inch in diameter, are filled below with earthy matter removed by the pupa in its progress. They can be traced by the color and compactness of their contents to the depth of from one to two feet, according to the nature of the soil. The upper portion, to the extent of six or eight inches, is empty, and serves as a habitation for the insect until the period for its exit arrives. Here it remains during several days, ascending to the top of the hole in fine weather for the benefit

of warmth and air, and occasionally peeping forth, apparently to reconnoitre, but descending again on the occurrence of wet or cold weather.

"The advent of hard rains sometimes develops the ingenuity of the pupæ in a remarkable way. On one occasion, about the time of their first appearance in one of our neighboring counties, there fell a series of heavy rains. Evidently the expectant Cicadas were seriously threatened with a fate like that of the Noachian world, and so set themselves to build an ark of refuge. A floating retreat was beyond their powers, but they literally rose superior to the situation, by carrying their burrows above the surface of the ground! Here is a drawing of one of these finger-like turrets, showing the exit hole from which the pupa escaped when the waters had subsided. Here I draw a section view of the turret, which shows the mode of operation. The pellets of earth have been pushed up above the surface to the height of from four to six inches, leaving in the center a gallery about five-eighths of an inch in diameter a continuation of the underground burrow. The outside measurement is about one inch and a quarter. The tube from which the drawing is made was a little bent at the top, but many turrets were straight and several instead of being single branched near the surface from a main chamber below, and a pupa lodged in each branch. You can see that this tube is a continuation of the burrow, and that the pupa when disturbed by the over-wet soil had only to mount to the top of its tower and be safe. When the time for transformation

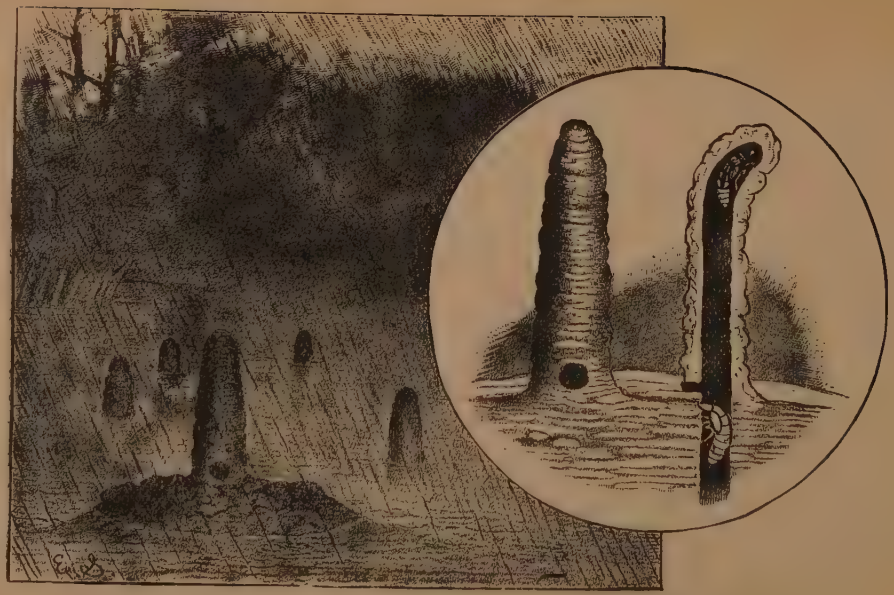

FIG. 118.—FLEEING FROM THE FLOOD—CICADA TOWERS.

came, it backed down the tube and escaped. (Fig. 118.)

"We have come now to the last stage in the history of this remarkable insect. The period for its great change has at length arrived. The seventeen years of grubbing in the dark ground are over. The voice of Nature is calling within with resistless power, 'Come up higher!' The time appointed for escape is usually the night. There would seem to be good reasons for this, for a host of enemies await them, and at best a multitude will perish. Different quadrupeds attack them; birds devour them; cannibal insects, as dragon-flies and soldier-bugs, make them their prey; even ants assail them with success, while hogs and poultry greedily feast upon them.

"For several nights in succession the pupæ continue to issue from the earth. Above fifteen hundred have been found to arise beneath a single apple tree, and in some places the whole surface of the soil has been cut as full of holes as a honeycomb by the eager insects breaking through their prison wall from their long confinement."

"At what time of year does this occur?" Abbey asked.

"The date of egress varies with the latitude. In the South the pupæ escape in February and March; here in Pennsylvania about the last of May, but in Massachusetts not until the middle of June."

"But the yearly kind comes out later 'n that," suggested Hugh.

"Yes; Pruinosa begins to appear with us about the

close of July, and for this reason has been called the Dog-day Harvest-fly. After the egress they mount the trunks of trees or other convenient object, and fasten themselves securely by their claws. Then occurs that change which most country-living people have watched with wonder. After a brief rest the pupæ begin to cast off their amber-colored skins. These have become hard and dry, and the work of emerging is not an easy one.

"At last, after repeated exertions, the shell cracks, a slit is made lengthwise along the back, through which the cicada pushes its head and body. Next the wings and legs are withdrawn in succession from their separate cases. The pupa is an imago now; at last it is free! It leaves its empty pupa-skin almost entire still fastened to the tree, and crawling to a little distance awaits the completion of its great change. At first emergence the insect is wholly unfit for flight. It is in a sort of border state of existence between its old earth life and its future air life, and is fit for neither. The wing-covers and wings are small and opaque, but, being perfectly soft and flexible, they soon stretch out to their full dimensions. The body is swollen to an unwieldy bulk, but in the course of a few hours the superfluous moisture has evaporated. The work of transformation is ended; the creature is a perfect insect, with strength to mount upon wing and fly. (Fig. 119.)

"Soon the rolling drums of the males are heard sounding their love-call to their mates. In a fortnight the mother insect begins to lay her eggs, and in the

FIG. 119.—OUT OF THE SHELL AT LAST!

space of six weeks the whole generation has sunk into silence and death. This ends my story; and now, Doctor, I yield theteacher's chair to you."

"My only difficulty in this case," the Doctor began, "is an 'embarrassment of riches,' for the Cicadas figure very freely in classic literature. They were especially in favor among the Greeks, who regarded them as sacred as the Egyptians did the Scarabaeus beetle. Indeed the Egyptians also evidently held the Cicada in reverence, for, in their hieroglyphics, a painted figure of that insect represented a priest and holy man, as well as a musician. I have been somewhat in doubt whether, in my selections, I may not have confounded these insects with the grasshoppers; but I think that in the following references the true Harvest-fly (*Tettix* in the Greek) is intended. Among the Grecians the Cicada was especially sacred to the muse of song, and its note bears the same name as the sound of the harp. A Cicada sitting on a harp was the usual emblem of the science of music. The origin of this custom, according to Strabo, was this: Two rival musicians, Eunomis of Locris, and Ariosto of Rhegium, were alternately playing upon the harp in a musical contest when Eunomis unfortunately snapped a string of his instrument. The accident would certainly have cost him the prize had not a Cicada, pitying the disappointed musician, flown to him, and, perching on his harp, supplied the place of the broken string with its melodious voice. Thus it secured to him an easy victory over his antagonist."

"That was very good, indeed, for Eunomis," exclaimed Abby, "but did the Cicada have no pity for poor Ariosto? It was partial dealing, I think, for a divine insect."

"True enough, Miss Abby; but the gods of Greece had their special favorites among the mortals, very much like the occupants of the political Olympus in these degenerate days. You mustn't ask me to defend the rather eccentric behaviour of the classic deities; I only tell the story as I find it.

"The poets seem to have been as partial to the Cicada as the gods, for its praise is sung by nearly every Grecian bard from Homer and Hesiod to Anacreon and Theocritus. Here, for example, is the way in which the muse of Anacreon celebrates its virtues:

> "'Happy creature! What below
> Can more happy live than thou?
> Seated on thy leafy throne,
> Summer weaves thy verdant crown.
> Sipping o'er the pearly lawn,
> The fragrant nectar of the dawn,
> Little tales thou lov'st to sing,
> Tales of mirth—an insect king!
> . . . . .
> Darling of the tuneful nine,
> Phœbus is thy sire divine;
> Phœbus to thy note has given
> Music from the spheres of heaven.'

"You can readily see from this how the highest commendation of a singer was to excel the Cicada in song. Naturally, the metaphor was carried into the realm of oratory, so that the music of Plato's eloquence was

only comparable to the voice of this insect. Homer, in his Illiad, compared his good orators to the Cicadas, 'which, in the woods, sitting on a tree, sent forth a delicate voice.'

"However, the complimentary bards do not have it quite all their own way, for here and there a protest is heard against the common praise. Virgil, in his Georgics, speaks of the Harvest-flies as insects of a disagreeable and stridulous tone, and accuses them of bursting the very shrubs with their noise. Whether this is a case of national jealousy, or evidence that the musical ear of Italy was as delicate then as now, I will not undertake to decide."

"It seems impossible," the Mistress said, "that so cultivated a people as the ancient Greeks could have been so destitute of musical taste as to attribute such virtues to the discordant squeaking of a male Cicada. It is really hard to believe!"

"Perhaps," the Doctor suggested, "you may prefer to explain the fact by a not uncommon social phenomenon nowadays. Have you not observed that it only needs that a few people of approved position and taste should declare a thing 'divine,' in order to bring the mass of so-called 'society' on their knees before it? Pray, how could the Greeks oppose the dictum of their literary guild and authorities of culture, combined with the tradition of their ancients? It would have been high presumption to trust their own ears in the face of such testimonies. But here is another protest which, perhaps, will not command the ladies' sympa-

thy quite so readily. It is an old witicism, attributed to the incorrigible Rhodian sensualist, Xenarchus, and gives a reason for the supposed happiness of the harvest-flies very different from that of Anacreon:

> 'Happy the Cicadas' lives,
> Since they all have—voiceless wives!'"

"O the wretch!" exclaimed the Mistress, laughing.

"To be sure, he was a wretch," I remarked, "and a false philosopher at that, for my observation has been that men are not only more curious, but more talkative than women. But I am obliged to the old cynic, nevertheless, for his couplet shows that even at that early date the fact had been observed that the males alone are gifted with sound-producing organs."

"I must not weary you with my quotations," the Doctor resumed; "but I may tell you that the rage for decorating the person with images of insects, which prevails so widely just now, is only a revival of an old custom. The Athenian elders, even before the time of Thucidides, were accustomed to fasten golden images of the Cicadas in their hair, and the same were worn as ornaments on dresses. These were emblems of their claims to being Autocthones (*Αὐτοχθονες*), that is, as we would say, Aborigines, original inhabitants of the soil. The significance of the emblem lay in the belief that Cicadas sprung from the soil, an origin which the Greeks might well be excused for attributing to them in view of their peculiar habits.

"I add that the Greeks, notwithstanding their ven-

eration for these insects, made them an article of food, and accounted them delicious. Ælian takes occasion to reprimand the men of his age for the fact that an animal sacred to the Muses should be strung, sold, and greedlly devoured! It does seem to have been very improper and inconsistent behavior; but the ancient Greeks are not peculiar among their fellows in devouring the objects of their worship, or, perhaps I should say, worshipping the objects that they devour."

CHAPTER XIX.

HOUSEKEEPING IN A BASKET.

THESE house chronicles do not record all the conversations held around the great sitting-room fireplace during the year of which I write. Since undertaking to edit the notes accumulated at that time, I have been compelled to omit many subjects. I am not sure that the most interesting themes have always been chosen for these published papers. At least, it is safe to say that many that greatly interested our circle will not here appear; for it only needed that we should unite our knowledge and experience upon the life-history of the humblest of the Insect Tenants of our Old Farm, in order to insure a fund of agreeable information. Certainly, some insects had greater attraction for us than others, but there was enough and to spare in the natural history of any one of them. Time and again our little circle learned the truth, well known to naturalists, that the objects which yield the richest store under investigation are those which lie nearest at hand. From such objects we selected our subjects, leaving many untouched; and from such selections again these published notes have been gleaned. I make bold to speak of this lest some one should think that these scant studies cover the field of entomology.

Nay; it is true here, as Jerrold said of the soil of Australia, one has but to "tickle the face of nature with a hoe and she laughs with a golden harvest." We but touched the surface of the Insect World in our Conversations, and I am scarcely doing so much in these notes.

Meanwhile, the season steadily advanced. Thanksgiving Day came in with a whirl of tempest and snow that marked the advent of winter. Again the days brightened, and the early weeks of December recalled the mingled softness and severity of November. Christmas came with its good cheer, and a sunny holiday week closed with a real winter storm, and a snow that whitened all the woods and fields. Shut in, as we were, by the heavy weather and our solitary site from the society of neighbors and friends, and thrown back upon our own resources for enjoyment, we came to look for the weekly or semi-weekly entomological meetings with increased pleasure. Surely there is a valuable hint here for many country homes. It is true that a specialist cannot often be found to lead the winter-night conversation; but the printed page of book or magazine may well take his place. There are few home circles where individual studies and observations could not add running comments of real value.

It was rare for us to pass the appointed time without a Conversation; and the preparation therefor—collecting and arranging specimens, making outline sketches and brief notes, gave to my mind an agreeable occupation that was quite needful alike to ward off discontent

and thoughts of business affairs. Change and rest gradually wrought their helpful mission, and healthful days and sleepful nights slowly returned to me.

To be sure, as the winter advanced, I lost the advantage of field studies, with the open air exercise which they involved. There was, indeed, opportunity for looking into the winter habits of my insect friends which was improved with good results; but for the most part we fell back upon the information gathered during summer and autumn. This was little detriment to our studies, as I had anticipated the difficulty, and assisted by my willing and active aids, had made large collections which could always be supplemented from the city museum.

"What is the fun?" asked the Mistress as I came in on one of these collecting days, bringing a handful of basket-worms.

"Only another example of Dan's 'curus' ways," I replied. "He has proved a real god-send to me, for I think it would be well nigh impossible in a month's journey to strike so rich a vein of superstition as lies under his black skin. He has given me a new insight of the strange relations between my entomological pets and my fellows, and shown me how deeply and strangely the world of men has been impressed by the insect world."

"Well, and what new discovery have you made this morning?"

"Something about these basket-worms. You know the large arbor vitæ tree in the back yard has been

badly infested by them ; the whole top was stripped of leaves, and the cone-shaped baskets were pendant from every branch. I fear the tree may be beyond help, but I resolved to try to save it by plucking and burning all the baskets. I ordered Dan to get the orchard step-ladder and help me in this work. I was surprised to see him hold back and seek to avoid the duty, but he finally obeyed and gathered the branches into a heap as I clipped them from the tree. However, he kept muttering over his task, and shook his head continually in a most solemn way. I set this down as one of his oddities and took no notice of it. The tree was stripped at last and a great pile of basket-worms gathered.

"Now, Dan," I said, "get a few kindlers and we shall make a little bonfire."

"Yo aint gwine to burn up dese tings, Mars Mayfiel', be yo ?"

"Certainly ; why not ? Come, hurry up !"

The old fellow took off his hat and stood twisting the brim around and around through his fingers. He looked as solemn as the grave. I began to show some vexation, I suppose, for he said :

"Mars Mayfiel', I done sarve yo tro and faiful, alluz ; an' alluz meanter do my duty 's well 's I know how. But dar 's some tings wat a man haint no right ter do, nur ax anoder man ter do for 'im. An' dat's jes one uv 'em. Ef yo'll please 'scuse me from doin' dat, I'll be powerful bleeged ter yo. I ax yo pardon, but clar to goodness, Mars'r I can't do dat ting."

I saw that he was in serious earnest, and relieved

his anxiety at once. "All right, Dan, I won't ask you to do this work if you object so seriously. But what's your reason for declining?"

"I done got conscience agin it, sir."

"Conscience! against killing these caterpillars that are destroying your trees? You surely can't be in earnest, Dan?"

"Can't help it, sah. I'se dead in yarnest, I shore yo. It's jes dis a-way. Dem's wat we uns call fire-wood billies [billets]; an' wat de ole folks saze is, dat dey is nuffin mo' nur less dan human critters wats a-been punished fer stealin' wood wen dey wuz alive an' in de body. Dey's jes been turned inter dese billies deyselves, an' so dey go aroun' totin dey sacks ob leetle sticks, and hangin' dar in de win', col' an' chill enough de whole winter froo. 'Tempsychoses—dat's wat Latimore's ole Aunt Sue used to call it. Now, Mars Mayfiel', I 'low you doan bleeve dat; but, yo' see, I *does;* an' I couldn't git consent nohow to 'gage in a-burnin' ob dem pore tempsychoses. Dey's punished enough, I reckon, already; an' dough dey is turned inter billies ob fire-wood, I doan want ter be de man wat put's de fire to 'em. We's all powerful weak, sah, an' like to go astray, an' ef ebrybuddy wat steals now-a-days done got turned inter billies, dar'd be a heap mo' tempsychoses hangin' 'roun' de trees, sah, dan dey is now. I doan' mean no disrespect, indeed I doan', but dat's w'y I can't 'bey dat order."

"Well, I have had a similar experience with Dan," said the Mistress, laughing, when I had finished my

story. "A few days ago I asked him to carry a bundle up-stairs and put it into the blue-room. He refused politely enough but decidedly. I wondered at his rebellion and asked him for a reason."

"I nebber goes inter dat room, Mis' Mayfiel'," he said, "an' I nebber did, and, please de Lor', I nebber will."

"Why not, Dan; what's the matter with the room?"

"Matter enough, ma'am. How d'yo spose dem tracks got up on dat ceiling? No dorg nur mann ebber walked ober de roof in dat away, head down'rd. No, no!" and he shook his head solemnly, "dar's been bad business dar. Yo' may depen'! No mortals nebber made dem tracks! An' ole Dan doan wan ter git his head in-under 'em."

The room which had thus excited Dan's superstition is a back chamber on the south side of the second floor. The ceiling has been preserved precisely in the state in which it was built a century ago. It is made of plain unpainted boards, which are really the floor of the loft above. The rough rafters upon which they are nailed show in all their virgin plainness. A small square boxed hole serves as a ventilator through the roof. The ancient side-door retains the old-fashioned "bobin" latch, and a very old chest of drawers adds to the quaintness of the chamber.

As one enters the room and glances upward, he is surprised to find a number of dog-tracks upon the ceiling! There they are, their strong leather-brown

color showing distinctly even against the age-browned boards. How did the dog-tracks get *there?* In one corner of the roof are the indistinct outlines of a pair of naked human feet. Some one seems to have scrubbed there until they are recognized with difficulty, but human footprints they certainly are.

The origin of these "tracks" has been for many years a fruitful subject for gossip among humbler country-side folk. But there is not much mystery about it according to the Townes family tradition. The board-yard at which the lumber was bought was also the tan-yard, and feet that had passed through the liquid tan had walked across and left their prints upon the boards which good Friend Townes had loaded up for his new house. No one thought worth while to plane them off, and so they were nailed down, tracks and all! Many a tidy housekeeper had tried her hands and temper at the task of scrubbing off the marks; but at last they came to be valued for their oddity. Nevertheless, there was this disadvantage, that in some minds the mysterious dog-tracks awakened nearly as much consternation as did the "handwriting on the wall" at Belshazzar's feast.

Poor Dan of course fell a victim to the mystery. Who would accept so simple an explanation as that which we have given? Too plain entirely, that! No, no; the feet that left those prints upon the ceiling were not of mortal mold! The room "wasn't zactly '*hanted*,'" Dan agreed, but he steadily refused to compromise himself with the "sperits" by entering

it. Queer old Dan! His character had a most harmonious setting in such a quaint old house.

In our conversation upon the "Tailor Insects," the basket or bag-worms had the first place. I had collected a number of interesting specimens from the old farm and from a grove at Shadybank, the home of one of my neighbors. These had been gathered from several species of trees widely differing in character—the arbor vitæ, white pine, larch, cypress, Scotch sycamore, American sycamore or buttonwood, English walnut, silver maple and sugar maple.

The caterpillar therefore has a wide range in the selection of its food-plant, and thus has immense advantages in the struggle for life and the chance to increase man's struggle.

"The basket-worm is the caterpillar of a species of moth sometimes known as the house-builder moth (*Oiketici*). The insects are also called *Canephoræ*, or basket-carriers, and the Germans call them *Sack-träger*, or sack-bearers. These specimens all belong to one species (*Theridopterix ephemeræformis*), which is widely distributed throughout our vicinity.

"Let us take up our history of the insect at the point when it appears as a larva. So far as we know, the eggs are laid by the female within the case, and are there hatched out. The first act of the young worm is to spin around itself a silken case, open at both ends. This becomes at last an extremely tough substance, narrow at the bottom, widened out at the middle, and again narrowed at the top into a tube, widest at the

FIG. 120.—BASKET ON PINE.

rim. Look at some of these cases; most of them are of this year's brood, and contain a crysalis, from which an Ephemeraform Moth will emerge next summer. Here is one that fed upon the pine; you observe how the long needle-like leaves of the tree have been attached to the outside of the case, and hang down far below the end (Fig. 120.) Here is another that has been made upon arbor vitæ, and the leaves and oblong

FIG. 121.—BASKET-WORM DRAWN UP TO FEED OR SPIN.

cones of the plant completely conceal the silken envelope. This tree or shrub is a favorite food-plant of this species, at least I have frequently found the worm upon it. Here is a third specimen, a small one, which is completely covered with the feather-like bracts of

FIG. 122.—A PROSPECTING BAGWORM.

the Scotch sycamore. A few stamens and bits of twigs assist the ornamentation. The case hangs to the mid-rib, and the opening cut in the leaf, all around the case-stalk, shows where the insect has been feeding."

"What is the use of these patches and bars?" asked Abby. "Are they simply for ornament like the beads and buttons that ladies sew upon their dresses?"

"I suspect that the caterpillar has not yet reached the stage of development at which it is either troubled or gladdened by the æsthetics of dressmaking. The habit is probably protective. And yet one would think that the extremely tough case which envelops it would be quite sufficient armor against all assault of foes and stress of weather. Nevertheless, this leafy coat of mail, which, as you see, sometimes wholly covers the sac, must greatly add to the protective value of the covering. The caterpillar has a soft, hairless body, and is thus more exposed to attack than many others; but certainly Nature appears to have favored this creature far above its fellows."

"How does the worm manage to trim her coat in this wise?" asked the Mistress.

"I have some drawings here that will enable me to answer you. But it will be necessary first to explain the manner of eating. The larva has perfect control of its own movements, notwithstanding the fact that it carries its house upon its back. It can thrust its body out of the sac-mouth until nearly the whole of it is exposed, and twist and bend itself in all directions. (Fig. 122.)

"I have seen specimens that had dropped from the trees hanging by a thread and squirming, bending and snapping their bodies in the oddest ways, while the case spun around like an old-fashioned distaff, which indeed it resembles. Now, when the caterpillar wants to feed it stretches out its head and neck, and moves them about until a satisfactory point has been secured. This it clasps with its pro-legs, which are hard, conical organs provided with sharp claws, and pulls up its body as you see at this figure (Fig. 121), and begins to spin. The spinning organs are near the mouth, and after several motions of the head, as though smearing the liquid viscid silk, the head is drawn back, thus drawing out a short thread. A similar movement is then made against one side of the mouth of the sac. This process is repeated several times until a stout stay-line is spun by which the

FIG. 123.—FEEDING ON PINE.

larva hangs securely. Now the creature is ready to feed. The behavior varies in this act, a good deal. For example, here is a sketch (Fig. 123) of a worm feeding upon the white pine. You may see the stay-line by which it hangs to one leaf, while it reaches to an adjoining needle, bites it off, and "sits" erect in its house comfortably chewing off the end which is continually shored upward by the two pairs of pro-legs that appear above the sac. This specimen made a very comical figure, and reminded me, when I drew it, of the attitude of a squirrel feeding on a nut.

"But more frequently the worm feeds without separating the leaf from the point of suspension. In the sketch, for example (Fig. 121), which I use to illustrate the attitude in spinning, we have the same position precisely as that taken when eating. The caterpillar has made itself fast to the under part of the leaf, as you see, and is gnawing at the edge, moving its head around as it eats. When the sketch was taken the leaf was nearly consumed."

"Can thee tell how the caterpillar is held within its house?" asked Aunt Hannah. "Does it lash its body to the inside?"

"I never saw a fastening of any sort in the cocoons which I have opened. The larva can turn itself around easily in its case, and go out at either end, although the head is generally upward. It clings to the inside of the case with the hooks upon its hinder feet, and so tenaciously that I have never been able to force one out, always being checked by the fear of tearing the creature

in two. I come now to the mode of attaching the leaf-cuttings to the case. So far as I have observed, this is always done at or near the mouth of the sac; at least I never saw a worm stretch its mouth backward and downward to sew a patch to the lower part of its case."

"But how do they get there? See here!" exclaimed Abby, "the leaves and chips are scattered all along the basket, from top to bottom. The caterpillar must have reached down to these points in order to fasten them there."

Abby's opinion evidently had a unanimous verdict of approval from the members of the circle who were carefully examining the baskets. I was therefore bound to defend my assertion.

"You forget, I think, that the Ephemeraform larva is a growing creature, unlike the moth itself, which emerges a perfect insect of full growth. It begins as a small worm, eats small quantities, and, as you may observe, down here toward the foot of the case sews on very small tags. But after it has fastened on these pieces—to the mouth, remember—it grows itself, and so also does the case, which it continually stretches and enlarges. You can easily see, therefore, that the mouth of the case is continually changing, moving upward as the worm feeds, just as does the opening of Aunt Hannah's stocking as she knits. The pieces sewed upon the cap of the case thus appear, in an adult caterpillar, precisely as they are here, scattered along the outside from top to bottom. Is that clear to you?"

"I quite understand it now," said Abby; "but I am still at a loss to know how the pieces are put on. Can you explain that?"

"In part at least; for I have seen the process in worms feeding upon arbor vitæ. Take one example which may illustrate others. In this drawing (Fig. 124) the worm has cleared a goodly space around it and has eaten along a twig toward the outer point. Now, suppose that just where its head is shown, it cuts quite through the twig, whether by accident or design I cannot say. Of course the outer part drops down. But, while eating, the worm frequently, quite constantly, indeed, spreads its viscid silk along the leaf and so keeps it attached *on both sides* to the upper edge of the sac, or to its own mouth-parts.

"Thus, the tip of the twig or leaf, when it is severed from the stem, instead of falling to the ground, simply drops alongside of the case to which it is held by the slight filament that attaches it to the sac, or as in many instances, to the caterpillar's spinnerets. In either case, the twig, leaf, stem, or cutting remains, and after being drawn up, adjusted and tightened by the worm, sticks tightly. As the creature is continually moving its spinning tubes around the top of the sac, these fastenings are continually being strengthened. Thus one piece after another is added, and so the basket grows. No doubt the animal varies her mode of procedure, but so far as I have observed, the process is as I have given it.

"Can the basket-worms walk with such big packs upon their backs?" asked Harry.

"That they can, and make pretty good time, too. I once timed one that was climbing up a tent pole, and

FIG. 124.—CUTTING A TWIG OF ARBOR VITÆ.

found that it traveled at the rate of three inches a minute, and could have made much better time, I am sure. It walked ten or twelve feet before it stopped, or rather, before I lost sight of it in a branch that overhung and touched the tent. Two others were tried in the same way with about the same results. They are odd looking objects as they go along, with their baskets hanging down, held out at right angles,

or even, when small, turned quite erect. Here is a drawing of one climbing a leaf-stalk. (Fig. 125.)

"But how do they manage to walk? I can't understand that," said Harry.

"The walking is done altogether with these three fore-legs. Let us suppose that the caterpillar has just made a step. Its head and the upper rings of the body are thrust beyond the case. It is holding by all its pro-legs. Now it prepares to take a step; it releases first the second pair of legs, and immediately after the first pair, at the same time pushing its head forward. The rings of the body extend like the joints of a telescope, and when the two first legs are ready to be set down, the fore part of the body is well advanced. Then the larva pulls upon the third pair of legs which hold tightly to the surface, and by wrinkling up, or more properly contracting the rings of the middle and hind part of the body, it hitches them forward, and, of course, the whole case comes along. That completes one step, and all others are made in the same way."

"Well, well," exclaimed the Mistress, when I had sent my sketch around the circle, "of all curious creatures which you have described to us, this basket-worm appears to me to bear away the palm for oddity. I begin to understand why one can be so patient and self-denying in nature studies. Really it must be a great pleasure to find out all these remarkable things."

"To me," said Aunt Hannah, "there is something more remarkable than thy husband's patience, or even the habits of his insect friends."

FIG. 125.—HOW THE BAG-WORMS WALK AND CLIMB.

"Pray what is that?"

"It is the fact that these creatures have been living their wonderful lives and working out their wise ways underneath my very eyes all my life time, and I never saw them! Since thee has spoken of it, Friend Mayfield, I remember having observed these objects hanging to the limbs of some of our own trees when stripped of leaves in autumn. But it never occurred to me to examine them. Indeed, if I thought about them at all, it was only to suppose them some part of the tree—

a cone, or something of that sort. I am ashamed, humiliated and amazed at my stupidity!"

"An honest confession, Aunt Hannah," I said, "and if all who are in like condemnation would speak with like candor, there would be a great 'army of confessors,' I assure you. But so it always has been. The 'seeing eye' is one of the rarest gifts in this world of ours."

"Shall I tell you what I have been thinking about?" asked Abby.

"By all means; something pleasant, I am sure, by your smiling face."

"I was thinking of the Jubilee Singers."

"The Jubilee Singers!" the Mistress exclaimed. "Of all things mundane, why of them? Your power of association will certainly turn out to be a greater marvel than we have yet heard of."

"I am quite in earnest,' Abby responded. "There is one plantation song which those colored students rendered that I never understood until to-day. It flashed into my mind while Mr. Mayfield was telling us how the basket-worm walks. Do you remember the lines?—

> 'Im inchin' along like a pore inch-worm,
> Inchin' along to Jesus!'

"Now, I used to think that over-rude, if not irreverent, even for a plantation hymn; for it never occurred to me before that the figure is a true and highly expressive one, drawn from the daily observation and adapted to the simple characters of those who sang

it, albeit somewhat vulgar to our ears. What could be more appropriate than the phrase 'inchin' along' to describe the motion of your basket-worm and other geometrids? And what more natural and apposite metaphor could be found for the halting, hitching, timorous progress of some souls in the spiritual life? If we grant that all objects in nature are of equal worth and standing, the 'inch-worm' is entitled to a place among poetic emblems, and the rude plantation hymnists' figure is a literary gem."

"I find myself in the affirmative," I remarked, "on all these points; at least I am not prepared to dissent from either the Mistress, Aunt Hannah, or Miss Abby. I suppose, therefore, that I may resume the story of the basket-worm, for I have not yet quite finished. Some one asked me if the caterpillar has a covering to the mouth of its case. No, but it has several ways of closing it. If it is walking along or feeding, at any alarm it instantly draws itself up and forces the open mouth closely against the stem or leaf, which then serves as a door."

"That 's just the way a snail does with its shell," suggested Harry. "I 've often seen 'em!"

"Precisely. The soft body of the snail is thus pushed within its hard shell while the rock to which it clings closes the opening. If the caterpillar happens to be hanging by the stay-thread or loosens its hold upon the leaf, it instantly grasps the upper rim of the sac just within the mouth and pulls the edges together over its head, as Harry might close a grain-bag with

his hands after backing inside of it. When the worm rests from feeding it proceeds in this way, and sews the mouth up securely. It will often hang thus during much of the day time, and in the cool of the evening come out to eat. I have seen the branches of an arbor vitæ tree fairly astir with the number of basket-worms that come out at nightfall to feed. Of course the exit is easy, for they have only to cut the inner fastenings with their sharp teeth.

"When the larva is about to become a pupa it shuts up the case in the last way described, casts off its last larval skin, and, without making any other cocoon, awaits its transformation.

"Do both sexes have the same bag or basket-making habit?" asked Hugh.

"Yes; but here comes in another remarkable fact in the life-history of our insect. Like the Orgyia, of which you have already learned, the female of Ephemeraform is wingless. Indeed, if you examine the specimen you will notice that she has the merest apologies for legs and antennæ — in fact, closely resembles her larva. A more helpless creature it would be hard to find; and so, like the discreet matron of Scripture, she is a "keeper at home," though, for that matter, there is nothing else for her to do. She never leaves her case, not even to receive her wooers, who must seek her inside her own house."

"How, then, pray, does she ever find a mate?" asked the Mistress.

"Ah! she is a thorough model of maidenly mod-

esty in that respect, for the mate always finds her. Nature has given him wings, decorated him with beautiful feathered antennæ, and made him in every respect a striking contrast to his fat, downy, grub-like partner.

"As soon as he has transformed, he abandons his secure castle and hies away to seek his true-love, which is now the one aim of his life. Undoubtedly, the retired habits of his ladye faire present serious obstacles; but then, when was ever true lover daunted by difficulties? Sooner or later he finds his mate, who, for her part, spends the short remainder of her life in laying a number of eggs within her basket home, wherein, by-and-by, a lively brood of young caterpillars are reared. They have regular, restless Anglo-Saxon dispositions, and, as we have seen already, are not content until they colonize from the old homestead and set up housekeeping for themselves. It was at this point that we began the history of the basket-worm, and here we must now leave it."

CHAPTER XX.

SARTOR INSECTORUM.

Our next meeting fell upon a genuine winter evening. Snow had fallen during the day, and although the moon rose full, yet ever and anon sharp squalls drove clouds along the sky, intercepting her rays, and dusting the fast whitening earth with feathery falls of snow flakes. Then the clouds scudded away, and the moonlight laid its glory upon the landscape. Looking out from our sitting-room window, we saw Luna's broad, jocund face hanging over a neighboring woods, and peering straight along the line of our wide avenue. In the open spaces the light sparkled among the snow crystals, which, as they drifted before puffs of wind, seemed like a phosphorescence of the frost upon a sea of snow. The lane and fields lay in a whiteness that was intense under the full moonbeams; shadows of the trees stretching down toward us were deeper in the contrast, and as the branches swayed before the gust, they shifted continually, so that their weird outlines looked like a dance of giants sporting on a crystal floor, and reaching forth their gaunt arms to catch the columns of drift that whirled by like veiled spirits of the storm.

Inside the old farm house a cheerful home scene was presented. Dan thoroughly understands the well nigh

lost art of "building" an open hearth fire. Flush against the chimney wall a great back-log lay, its heart already well uncovered by the gnawing flames, whose huge triangular bite was all aglow with rosy embers. Hickory sticks of various sizes, laid on in delicate gradation, were piled atop of the andirons in front of the back-log. How the big fire did leap and laugh, and spit and sparkle, and hiss and crackle as the flames ate their way into the wood! The bed of coals beneath continually grew as splints and chunks fell off from the fore-logs, curled up into glowing color upon the hot bed, and then melted away into the common mass of embers. In the hearth-corner the tea kettle kept up a genial sizz-z in answer to the kitten's purr, and the old-fashioned brazen standards of the irons seemed from their polished bulbs and rings to reflect the comfort, brightness and genial warmth of the whole precincts of the hearth.

Winter snows are the true soil for the generous culture of home. Home life, home love, home pleasures are indigenous growths in lands where the Frost King claims some season for his own. How one hugs his hearth-stone and feels his heart leap up with its fire-flames in gladness over his well-housed loved ones, when he hears the storm rattling at his window!

The table was wheeled in front of our fire, the lamps were lit and set upon it, together with boxes of specimens, books and the invariable folio of manilla paper for illustrations. Why is it that on such occasions the ladies are sure to find some pleasant and useful occupa-

tion for their fingers? Certes, they present a graceful and pleasing feature in the home circle, with pretty work-baskets at their sides filled with its paraphernalia of thimbles, scissors, emery-bag, needles, pins, spools and divers odds and ends, with rolls of broidery bright with many hues on their laps, or tidy pieces of plain sewing, or meshed bands and bundles of knitting work, while trim fingers move briskly, and the tools of their delicate handicraft tinkle amid the music of their tongues. To say nothing of economies, these womanly ways are a vast contribution to the æsthetics of our houses, and show in notable contrast with the ungraceful, even ungainly over-consciousness of hands and the mystery of what to do with them, which so often characterize the male portion of a family circle.

These reflections were started by a glance around our sitting-room on that winter night. All the ladies had some pleasant work for their fingers; even the click of Sarah's knitting-needles sounded out of the kitchen shadows. But the masculines betrayed by their awkward attitudes and restless movements the need of some occupation for their hands to give their bearing poise and gracefulness.

Who will discover for man's fingers a suitable and congenial home employment besides rotating a newspaper and manipulating a cigar? For such a genius a monument more enduring than brass awaits.

"Thee spoke of insects *sewing*," said Aunt Hannah, as we began our Conversation on Insect Tailors amid the above congenial surroundings. "I have looked

over these specimens, and have seen nothing that can fairly be called by that name—at least according to our ideas of such work. I think I should speak of the basket-worm's labor as pasting rather than sewing. Nor do I see anything different in these nests of spiders, leaf-rolling caterpillars and cutting bees."

"That is true," I replied, "if we concede that sewing requires the use of a needle or needle-like implement. Our insects do not sew their nests together in the sense or fashion of the tailor-bird or fan-tailed warbler, for example. But suppose we define sewing as the art of making an artificial covering for the body, then the basket-worm is a true insect tailor, is it not?

"Or, again, suppose we

FIG. 126.—SEWED LEAF-NEST OF THE INSULAR SPIDER. (EPEIRA INSULARIS.)

define sewing as the art of joining together separate pieces of pliable material by means of threads. Then our basket-worm as well as these leaf-rollers and spiders are true tailors, for certainly they do unite leaves into nests by silken threads stretched from one to the other. (Fig. 126). Here in this nest of the Insular spider, made in a hickory leaf, you can distinctly see the threads crossing the seam from side to side, from one end to the other. Here are some nests of the beautiful Shamrock spider, one spun among the leaves of some vine unknown to me (Fig. 127), the others made out of the leaves of a fern. They are beautiful objects even now as dried specimens, and were far more shapely when seen in nature. Now, in these cases and all similar ones, the ends of threads have been made to adhere to instead of passing through pieces after having been drawn taut, but the effect is precisely the same in both modes—the threads pull the pieces or parts together, and hold them so. That, I think, may fairly be classified as tailoring, may it not ?"

"Yes, but here is a difference," said Abby, joining in the discussion. "The art of the tailor or seamstress has for its object the clothing of the body. Now, if we admit that the basket-worm's case is really such a covering, a true coat or frock, if you please, you cannot say the same of these spider structures. According to your own showing they are houses, not garments."

"Well put, Miss Abby, and you shall be fairly answered. During the bright autumnal days I pitched

FIG. 127.—LEAF-NEST OF THE SHAMROCK SPIDER. (EPEIRA TRIFOLIUM.)

my tent upon the lawn and used it continually for an office and outdoor library, so that by the physician's advice I might be as much as possible in the open air. My tent is *sewed*—a house or shelter of various pieces of canvas wrought together by the tailor's craft. But what will you do with it if you refuse to allow the spider's nest a place among sewed structures because it is a tent and not a garment?" (Fig. 127.)

"Really, Abby," smilingly remarked Aunt Hannah, "I think that we must admit that Friend Mayfield is right, and receive his insect friends into our worthy guild of spinsters, tailors and seamstresses. For one, I am better content with their association than I would have been before I was favored with a place at these Conversations."

"Thank you, Aunt Hannah. And now I shall present for the honor of membership a new candidate, the Leaf-cutter Bee (*Megachile centuncularis*). You have better reason for denying her claims to place among the tailor insects than the others; but on the strength of the importance which I know the cutting department to have in all sewing operations, I venture to include her within this group."

"Oh, we will all vote to admit her!" exclaimed the Mistress. "Bees are such genteel insects, and so interesting withal, that any member of such a 'highly respectable family'—to quote a favorite Philadelphia phrase—shall not go a-begging for a seat among the seamstresses. By all means, let us have the leaf-cutter bee."

"Well, then, here she is—a thick-bodied insect with a large square head armed with stout jaws. She is not provided with a pollen-basket like the honey and humble bees, but Nature has placed a thick mass of dense hair on the under side of the apex of the abdomen or tail, which she uses for the same purpose.

We have two or three species common to the Eastern United States [*Megachile centuncularis*, *M. integer*, *M*

brevis], having nearly the same habits, which indeed differ little from those of their European congeners. The insect begins her nest by boring a hole about the diameter of her own body in the soft pith of an elder stem, or the soft wood of some old tree. Sometimes she digs a cylindrical hole in a beaten pathway. Sometimes she economizes her labor by choosing the hollow of a tree, the shelter of a cornice, or the cavities of an old wall for her home-site. This done, she seeks her favorite plant, which is commonly a rose-bush, and begins to harvest leaves.

"She makes the cut in almost the same way as the cutting ant, as I have heretofore described it. She flits from leaf to leaf, not that there appears to be any ground for a selection, but somewhat on the principle (whatever it is) that moves certain ladies in their shopping expeditions. At last she is satisfied, settles upon the leaf, clinging by her feet to its edges. Then she draws her scissors which she carries not at her belt, but on the end of her face. In other words, she opens her mandibles, which are well ordered tools for the purpose, and makes a slit into the edge of the leaf. Thence she moves rapidly around the major part of a circle, using her jaws as though one point of a pair of compasses and her feet as the others. The jaws work precisely like a pair of scissors, and with each forward slit the legs are hitched farther along, until the opposite edge of the leaf is reached. Now she holds the cutting in her jaws, balances it while she poises her body upon fluttering wings, adjusts the severed piece

between her hind legs and flies away to her hole. Here is a figure representing leaf-cutter bees engaged upon a rose-bush, and beneath them are samples of the cylindrical nests which they construct." (Fig. 128.)

"How long does it take a bee to cut out one of these pieces?" asked Penn Townes.

"One individual whose movements were timed, cut, carried ten yards to her nest, fixed the leaf in its place, and returned to the rose-bush on which she was working, at intervals of from half a minute to a minute, and kept this up during an entire morning."

"Pretty rapid work that!"

"Yes, and you will appreciate it more highly when I shall have told you how she disposes of the leaves. If you turn to our figure (128) you will notice first that the leaves have been used to line the inner surface of the hole, and that they form a tube not quite three inches long, which consists of several 'joints,' as I may call them. If you will examine the joints you will perceive that each is made up of three or four pieces, and that the serrated edge, or natural selvage of the leaf, as the ladies might say, is invariably placed on the outside, while the cut margin is put innermost. Do you observe these points?"

"Yes, we all see."

"Here is another fact, if I am not much mistaken," said Hugh. He had been examining the nest carefully, and, as it proved, with a true mechanical eye. "If you take purtickler notice, sir, you'll see that in formin' uv these jints the bee has been careful not

FIG. 128.—NEST OF LEAF-CUTTING BEE. (AFTER BLANCHARD.)

to put a jinin over a jinin. She has laid the middle or solid part of every piece fernent a seam, an' I don't find nary seam that jines onter another seam. Bein's ther's so many pieces and seams, thet looks es though it mought a-been done a-purpose. Ain't it so?"

"You are quite right, and have proved yourself a

good observer, for this point has attracted the attention of naturalists. It would really seem that the skill of an experienced joiner had been brought to bear upon this leafy tube."

"How are the pieces held together?" asked Abby. "I don't see any seam—I don't mean Hugh's sort, but the kind a seamstress makes. There's neither sewing nor pasting visible. Are the seams inside?"

"Now you have raised the point which I had in mind at the outset when I spoke of the doubtful claim of the leaf-cutter bee to a place among Tailor Insects. In point of fact there is no sewing here at all—not a thread used. The leaves are held in place by the natural spring of the leaf alone. Here are a glass lamp-chimney, a pair of scissors, and some bits of paper. Who will try her hand at building an artificial bee's nest? Miss Abby volunteers! Very well, Penn may help you if he will, and see how you two will get along at the mimic work of nest-making."

The Mistress cast a sly glance at the Schoolma'am, whose pink cheeks reddened as she shook her head threateningly at me. Aunt Hannah looked up quickly from her knitting, and shot a disapproving glance across the table. It would have been an angry glance, perhaps, if the good lady could have nursed wrath, for the growing interest that Penn Townes took in the Yankee maiden was a sore trial to her. Abby was, indeed, all that her mother love could ask for her son, with one exception—religion. How could she bear to have her only child "turned out," deprived of his birth-

right privileges for "marrying out of meeting?" She who already sat in the front seats? whose husband now sat side by side with the head of the meeting, an honored elder? That long line of ancestral faithfulness and honor in the belief and fellowship of Friends, should it be broken off and cease forever by the rebellious act of *her* son? Poor, dear woman! it had come to be a great concern upon her mind, and a bitter cross to carry.

It was but human that we should sympathize with her struggles within these hereditary bonds; but for all that it was natural for us to wish success in our hearts to such a thoroughly well-appointed match. Yet between Abby's high spirit and old ideas of propriety, and Penn's affection for his parents and conscientious regard for his ancestral form of Christianity, the issue seemed more than doubtful. But whither am I wandering?

Let us hasten back to the leaf-cutter bee and her nest-making.

"About ten or a dozen cuttings are required to form one cell. Each cutting is bent into a curved form, and pressed into the burrow in such a manner that the pieces fit successively into or overlap one another, and form a small thimble-shaped cell, which is narrowed at one end, and gradually widened at the other until the width equals half the length. In this the mother bee puts a single egg and some bee-bread, a substance composed of pollen mixed with honey. Next she covers in the opening with two or three circular pieces of leaf, so

as to keep a baby bee within its own proper bounds, and proceeds to make another cell."

"How many cells does she make, sir?" asked Hugh.

"The nest from which our illustrations were taken contained thirty cells. These were not arranged continuously, but in nine separate rows or series of unequal length. The longest row contained six cells, and was two and three-quarter inches long. The whole leaf structure was equal to a length of fifteen inches, and contained about a thousand pieces. I have often wondered at the rare patience of some of our lady friends in building a patchwork quilt out of no end of bits of silk and other stuff. But here is an insect who may fairly rival them."

"Here's your model nest," said Abby, who had by this time completed her task. "I should have found it a far easier work"—laughing—"if I could have crept inside my burrow, as the bee does, instead of limiting entrance to a finger or two. But I have been thinking that you have assigned these insects the wrong trade, after all."

"How is that? Where do you place them?"

"With the upholsterers. These leaves are tapestry. The bee hangs them upon her walls and ceiling, and lays them as carpets upon her floors. Her handicraft is upholstery, and therein I vote to put her."

"Very well, put the little artificer where you may she furnishes an interesting study. By-and-by her eggs become larvæ, feed upon the bee-bread provided by the Forethought uttered through maternal care,

FIG. 129.—ROLLED LEAF-NEST OF TORTRICID MOTH. (FROM NATURE.)

spin a slight silken cocoon about the tapestried walls of their cradle-cells, go into the pupa state, and in about a month become mature bees, and cut their way out into the broad world to fill up their part of Nature's unending round."

"Perhaps the most perfect examples of the tailor's art in the insect world are found among the Lepidoptera. Butterflies, and especially moths, are famous for sewed habitations."

"Moths!" exclaimed the Mistress. "You amaze me. I thought they flitted from flower to shrub, and build themselves no homes at all."

"That is true of the imago or winged insect," I answered. "But you forget that the adult life of moth or butterfly is the shortest part of its existence. In that estate it is really an uninteresting creature, for the most part, and challenges attention chiefly by its form and colors. It is in the caterpillar state, the most odious to the ordinary observer that the naturalist finds the most interesting habits. Here, now, is a nest made probably by the caterpillar of a species of Tortrix. I found it on the edge of the woods back of Asbury Park within sight of the ocean. I have seen multitudes of these globular nests about the size of an English walnut, rolled up at the tips of the leaves of the great fern, *Aspidium thelypteris* (Fig. 129.) See how deftly the leaves have been rounded and sewed into this spherical mass! And here is the little door out of which the transformed insect made its escape. Small forests of this fern grow in low and moist places along our Atlantic coast, and there you may find colonies of this leaf-roller or their abandoned nests in the months of July and August."

"I have often noted those clumps of tall ferns in my summer saunterings by the sea," remarked Abby; "but

I never came across any of these beautiful objects, I am sure."

"Doubtless thee came across them, but never *observed* them," suggested Aunt Hannah; "but that was before thee had learned the value of the 'seeing eye' by Friend Mayfield's Conversations. I warrant that hereafter thee will see more things in thy vacation jaunts than thee ever dreamed of—at least, I can say as much for myself, I think."

"I stand corrected," returned the Schoolma'am, blushing. "But," she continued, "I have learned the value of a seeking tongue if not of the 'seeing eye'; so I will e'en ask, what is the purpose of this nest, and how is it made?"

"A fair enough question," I answered; "but I fear that I must somewhat disappoint your curiosity. However, I will tell you what I know about other leaf-rollers, and we shall thus, perhaps, easily infer how this pretty spherical nest was made. To begin with, this, like all nests of leaf-rolling caterpillars, is the home of a single insect. The mother moth deposits its eggs separately upon the food-plant of its young, appropriating a leaf to each egg. As soon as the caterpillar is hatched it begins to spread its leafy tent above it, impelled thereto by the double purpose of securing itself from predatory birds and assailing insects, and of providing adequate food. It is not only important for it to feed, but to feed in safety.

Sometimes the little hermit commences work upon the upper, sometimes upon the under surface of the

leaf. Its mode of operation is generally very simple, and you will better understand it by looking at these figures (Figs. 130–131), which show the nest of the Oak-

FIGS. 130–131.—WORK OF LEAF-ROLLING MOTH. (AFTER RENNIE.)

leaf roller in several stages of progress. The caterpillar fixes to the edge of the leaf a few short threads, which it spins from its mouth, and draws them to the opposite edge ; or it stretches a thread from the tip and edges of the leaf to the mid-rib. Next it takes position at or near the middle of these lines and bears down or pulls down upon them. Of course the tightening of the threads naturally curls up the edges of the leaf. Do you understand that, Harry ?"

"Well, I—I——," began the boy.

"Speak straight out, lad !" said Hugh, "and don't be ashamed of honest ignorance. Let your yea be *yea*, and your nay, *nay*, and don't worm around the truth when it's put straight to ye."

Thus admonished by his father, Harry uttered an emphatic, "No, sir!"

"Very well, let us try an experiment. I loop an end of these cords into the edge of this sheet of paper. So! I take these pins and fasten the other ends of the cords into the sheet, thus—just far enough along to tighten the cords and lift up the edge of the paper a very little. Now take this stick and push down upon the middle part of the cords." (Fig. 133.)

FIG. 132.—NEST OF LEAF-ROLLING CATERPILLAR.

Harry followed my directions, and as the edges of the manilla sheet, drawn upon by the taut string, raised and curled over, his face lighted up with a bright smile, and he exclaimed:

"Oh, it's plain enough now! I quite understand!"

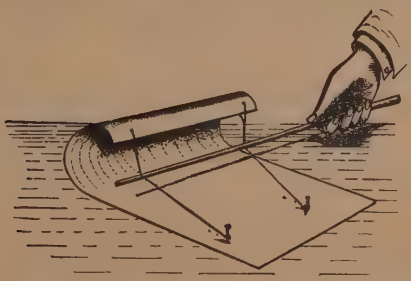

FIG. 133.—SHOWING HOW THE LEAF IS CURLED.

"Very well," I continued, "let the stick drop down to the paper. Here at the points where the cords touch I thrust pins through them into the table. Remove your stick now, and there! You see that the sheet reemains quite curled over. That is substantially the leaf-roller's mode of curling a leaf; except, of course, that, instead of pinning down its threads, it glues them down to the leaf; and, by a succession of like operations, succeeds in making one complete roll or cylinder, and then another and another, until its full growth is attained.

"And, now, you want to know what the caterpillar does in its leafy tent? Well, having made its home, it straightway proceeds to eat it."

"Verily," said Aunt Hannah, who could not resist the opportunity to draw a moral lesson, "there are human beings who have the same unhappy faculty. Many a good house and fair farm have I known to disappear down the gullet of the glutton and wine-bibber. Truly, Holy Scripture well calls man 'a worm'—although, perhaps, Friend Mayfield, thy caterpillar doesn't exactly illustrate the mind of the Spirit in that phrase."

The closing sentence was evidently forced into this apologetic strain by the smile which I could not restrain at the quaint use which the good woman had found for my little leaf-roller.

"Pardon me," I said, "your lesson is not less profitable because it awakes mirthfulness. But really, Aunt Hannah, you have done the worm injustice by

your metaphor. The creature never eats itself out of house and home after the fashion of our species; it cuts windows and doors through its leaf partitions, passing thereby from one to another, but the instinct which urged it to its first act of protection prevents it from destroying its outer defenses."

"In other words," said Abby, speaking up sharply, "a worm will do better for itself under the sway of Instinct than some men under the rule of Reason. Why is that?"

"Excuse me, Miss Abby, if I decline to follow up your question fully. It would lead us into very deep waters, indeed, and we should perhaps need Dr. Goodman to bring us back to harborage. But let me say there is some strange element which somewhere in man's history has overpassed the bounds and bars of the common laws of Nature and found place within him. It is peculiar to him—alien from his fellow-creatures of the lower orders. It has jarred his nature at many points, and made it discordant with the catholic Unity and Law. It has set him upon paths that lead to depths below the brutes. Sovereign of the creatures as he is, it has yet betrayed him into inferior traits, and shown him the baser and weaker vessel. At some point in history man's inner constitution has undergone a strange—a terrible revolution. When was it? What is it? I cannot say—at least I will not say now. I do not know——"

"Friend Mayfield, *I* know, if thee does not!" Aunt Hannah dropped her work into her lap, and broke into

my unfinished sentence with very firm but tremulous voice. "It is an old, old truth. Why should thee spare to speak it? 'God hath made man upright, but they have sought out many inventions.' That is the strange element, the fact, the revolution which you are thinking about; *sin hath entered in!*"

It was plainly a truth in which Aunt Hannah did not glory, for as she finished her sentence and resumed her knitting, her mild eyes slowly fell, and tears trickled over the white cheeks and dropped into her lap.

It was an unexpected diversion from our theme, and an embarrassing silence came upon the room, whose solemnity old Dan interrupted in his own peculiar way. He had sunk from his cricket almost into the attitude of prayer, and, with hands clasped over his breast, swayed to and fro.

"Good Lor', hab marcy!" he at last exclaimed. "Dar's no denyin' hit—we's all pore sinners, shore 'nough, and is chock full uv upsottin' sins. Hit's jes dat, Mars Mayfiel', and nuffin else. As de good Book saze, hit 's de *upsottin sins* w'at 's done de damage."

"Shall we go back to our subject?" I asked, after a moment's pause.

"I was a-thinkin'," said Hugh, "w'ile you and the ladies was talkin', that I 'd like to ax you a question about worms." The good fellow had evidently small interest in a discussion of that phase of man's natural history which relates to human depravity. Indeed, he

was on such honest and kindly terms with himself and all his fellows that it had probably never seriously occurred to him to think of himself as very much of a sinner. He had therefore engaged his thoughts upon another subject during our theological digression. "I was a-wonderin' w'at sort uv varmin is them apple-tree caterpillars. I allow they mought be tailor insects, too? 'Tall events they 's mighty peert at spinnin' and leaf-curlin', and powerful destructive on the leaves. I'd like to know w'at you make out'n them."

FIGS. 134 AND 135.—FEMALE AND MALE OF THE TENT-CATERPILLAR MOTH.

"You are thinking of the tent-caterpillar," I answered, "and an interesting fellow he is, although his habits are certainly against him. We have two common species closely resembling each other in form and alike in habit. They are the apple-tree tent-caterpillar (*Clisiocampa Americana*), and the forest tent caterpillar (*Clisiocampa sylvatica*). The moth is a dull reddish or reddish-brown color, and the female measures about an inch and a half across the expanded wings (Figs. 134 and 135). The hollow tongue or tube by which moths imbibe their food is entirely wanting in

this species, hence it has no power of taking food, and lives but a few days in the winged state, during which time the eggs are laid. A large number of the nocturnal visitors to our lamps during the evenings of July belong to this Clisiocampa, and so, without knowing it, you are all familiar with the creature, as you have seen its bewildered behavior when it enters our lighted rooms and flutters wildly about the often fatal flame.

"The eggs are deposited upon the small twigs of fruit trees in ring-like clusters, each composed of from fifteen to twenty rows, containing in all from two to three hundred. They are firmly cemented together, and coated with a tough varnish impervious to rain. The young larvæ are fully matured in the egg before winter comes, and they remain in this enclosure in a torpid state throughout the cold weather, and hatch during the first warm days of spring. Their first meal is made of the gummy material with which the egg masses are covered, and their next of the tender buds just bursting.

"Soon after hatching they begin to spin the tent-like shelter which gives them their name, by stretching silken threads from point to point across the forks of the twigs whereon they have been cradled. As they grow they spin new threads, laying them one atop of another, and extending them to adjoining twigs, until the spinning-work has become a close sheet by the repeated overlays. The structure is now more or less irregular in form, according to the relative position of the twigs which support it. Often the nest is located

FIG. 136.—NEST OF THE TENT-CATERPILLAR MOTH.

at the top of the twigs which, having a general conical outline, give it naturally the appearance of an old-fashioned Sibley tent or Indian wigwam. (Fig. 136.)

"The resemblance is frequently very striking, as may be seen in this figure of a forest tent-caterpillar's nest which I saw growing upon a wild cherry-tree at the base of Round Top on the famous battle-field of Gettysburg. Numbers of similar structures were fixed among the branches of various trees, whose white texture was brought out sharply against the dark-green of the embowering leaves. As I turned from them and gazed

upon the martial city—an encampment of the National Guards—whose canvas tents were pitched upon the battle plain and swelling ridge over which the gallant but fruitless charge of Pickett's corps was made, I could plainly see that likeness to which our tent-making caterpillar owes its popular name. The tent here figured was about ten inches in diameter acro s the base, and its height was nearly the same; this is about the average size, but many of the tents are larger.

"The holes through which the caterpillars enter are near the extremities or angles of the nest, into which they retreat at night, or in stormy weather, and dwell when not feeding. They have regular times for feeding, and may be seen marching out of their tent-doors in processions usually twice a day, forenoon and afternoon. These processions move in single or double column, over sidewalks, along fences, trunks and branches of trees, until they reach their proper food-plant which they attack with a voracity that brings serious damage when the nests are numerous.

"In five or six weeks they mature, when they leave the trees under the resistless impulse of Nature, and wander about in all directions seeking suitable places in which to hide during their crysalis stage. Presently you will find them under the cap-boards and cross-rails of fences, in angles, recesses, and beneath projections of various sorts, spinning tough, yellow oval cocoons enclosed within a slight shelter of threads. Within these cocoons the larvæ change to brown

crysalids, from which the moths escape in two or three weeks."

"Well, sir," said Hugh, "it's an amazin' pleasin' history that you've given us, but you'd make it a heap more interestin' to farmers ef you'd tell us wat to do to git rid uv the worms."

"Against some of our insect enemies," I replied, "man struggles at great disadvantage. They attack him in such insidious guise at such unexpected times, at points so inaccessible, in forms so minute, in numbers so immense, that the wisest and most diligent may be taken unawares. But our tent-caterpillars are no guerillas, but right honest and open foes. They pitch their camps under our very eyes and march out to assault like genuine soldiers in broad day. If a farmer does not exterminate them or hold them within harmless limits he suffers from his own laziness, indifference, or neglect."

"Well, yes, that's so, I reckon," Hugh responded. "But the plague on 't is that sech a feller's acres git to be a breedin' ground for all sorts uv nuisances, and the rest on us have to suffer with him."

"True," I said, "and then there is no remedy but the law; and the time will come, perhaps, when farmers—who have the majority of votes—will not think it beneath their dignity to enact laws concerning the destruction of insect pests."

CHAPTER XXI.

NATURE'S FIRST PAPER MAKERS.

BEFORE snowfall one of the most beautiful walks from the Old Farm leads over the Crum Creek hills to the paper mill of Mr. Lewis Howard. The path threads the meadow by the Cave Stone, crossing Townes' Run, and so over the field along a pleasant lane to the woodland which is, in fact, the east bank of the creek. A wagon trail winds through the wood along the verge of the hill and enters the mill road flush upon the creek side.

The stream in this vicinity is quite sinuous, and cuts its way by a steep channel among the hills which on either side form the banks. These are in many places so abrupt and heavily wooded, that one pushes his way with difficulty through the underbrush. Here is the "forest primeval;" here Nature is held in a virginity pure as that which the white man seized from the red Indian's hand. In this wild park Flora holds court, and beneath the boughs of chestnut, oaks, hickory, maple, beech, birch, dogwood and hemlock are gathered clumps of laurel, sumach, mammoth ferns, and all the wood plants and wood flowers of the whole region.

It is a paradise of wood insects, too. The large black Pennsylvania carpenter ants march in columns along

the great tree trunks, at whose roots heaps of chippings lie, showing the industry of the busy woodworkers within. The Fuscous ants (*formica fusca*) here delivered from the taint of slavery to their Sanguine or Shining Masters, take on an air of forest freedom and build broad mounds fearless of remark instead of skulking within hidden dens ; beetles, crickets and numberless other insects push a thousand trails under the fallen leaves and branches.

Here Arachne has gathered many children as into a safe nursery. The woods swarm with spiders, whose webs of varied sorts and sizes hang from limbs, stretch over the water, overlace roots, rocks, crevices, hollow trunks, leaves and logs, and extend from branch to branch across every opening, flapping their sticky filaments in the passer's face. How often have I gone to this resort, when anxious to collect a specimen or verify or complete a study of aranead habits, confident that somewhere in this narrow belt of forest my search would be rewarded !

At the point where the wagon trail leaves the woods the creek runs close along the mill road, then gradually hugs the opposite hillside, leaving a narrow strip of flatland. It is bordered by a fine row of trees which overhang the water. The proprietor has an admirable peculiarity for an American. Some kind genius has written deeply upon the fleshy tablets of his heart the well known plea, "Woodman spare that tree !"—written so deeply, that he will never allow one tree to be cut down if there is any possible way to

avoid doing so. At the end of this row of trees the creek and road make a sharp angle or horse-shoe bend, and bring into view the Franklin Mill. It is a large fine stone structure, set close against the hill and flanked on either side by pretty stone cottages for the workmen. The proprietor's mansion sets upon the crown of the knoll and overlooks the whole pleasing scene.

It would be hard to find a mill site more charming and romantic than this. The overhanging trees flushed with the growing hues of autumn ; the rippling music of the creek, as it issues adown the deep ravine, mingling gradually with the thud of water-wheels and clatter of machinery ; the shout of a merry group of children jumping the rope before a cottage door ; the sun lying warm and bright in the lap of the beautiful glen shut in from all sights and sounds of the outside world—surely the venerable, kind-hearted proprietor who looks on such a scene from his house on yonder hummock, must feel that the lines have fallen to him in pleasant places !

We had taken this walk one day over the withering autumnal fields, among the rustling leaves, through the smell of wood-mold—how sweet to the forester !—along the beetling banks of shady Crum Creek, for the purpose of seeing the process of paper-making. Our next Conversation touched those natural paper-makers, the wasps ; and some of our circle wished to draw a comparison—or will it be a contrast ?—between the human and the insect methods. We are not to lead our readers through the details of the process as

pointed out to us by my friend and landlord Mr. Howard, although that might be new, and certainly would be interesting to many. It will suffice that the mode consists substantially in reducing vegetable fibre of wood, straw, cotton, hemp or flax into pulp, from which the moisture is excluded and the residium exposed to a pressure that reduces it to flat sheets. The quality, surface condition and size of sheets are matters quite apart from this essential process.

Somewhat thus I briefly stated the results of our visit to the mill, at our conversation. "Have I put it correctly, Mr. Howard?" I asked, for that gentleman, hearing what subject was to come before us, had asked leave to attend.

"Yes, that is about the substance of paper-making," was the reply. "It seems a very simple one, as you put it, sir; but—there's a whole sea of trouble between that brief statement and even such a result as this"—laying his hand upon our manilla illustration paper. "However, you have hit the fundamental principle of the thing pat enough."

"Very well, that is all I care to do. Now, here is a wasp's nest (Fig. 137.) It was collected from the premises of the old Springfield Central school, where our friend, Miss Abby, is now engaged. The plain, square, two-story building, as you know, stands in an open, flanked by a grove of more than a score of tall oak-trees. The branches of these oaks are thickly colonized by ringed wasps — "Tailor wasps," I find they are called by the country-side people. On one

FIG. 137.—NEST OF THE RINGED OR RUST-RED WASP (POLISTES ANNULATUS.)

tree I counted thirteen nests, and I am quite sure that more were hidden among the leaves. Every tree is occupied, and several nests are hung upon the blackberry vines that skirt the fence close by the wall. Thus, while some of the wasps swing their domiciles far aloft, fifty or sixty feet above ground, others choose sites nearer terra firma. This indifference as to location is more or less evident among those who, like the famous Swiss Robinsons, build their houses in trees, for the nests are scattered indifferently throughout the branches, one of the largest which I have seen being pendant from a limb that bends quite

low. The colony has occupied the school-house grounds for at least a half-century, for men who were boys that long ago remembered them well. I fancy that exposure to the raids of destructive boys during all these wasp-generations has not been without effect upon the insects, for most of the nests are placed well out of reach. Indeed, one wonders that any mother-wasps could be found so far freed from a strain of hereditary caution as to venture a location within reach of puerile projectiles.

"It is an interesting sight to observe the worker wasps gathering material for their nests, and it may be seen on any summer day along the lines of fences near the school-house. I have often tried to keep a worker under observation for a prolonged period, but have failed beyond a few consecutive moments. The creature is a perfect embodiment of restless activity. It alights upon a weather-beaten spot, and, bending downward its head, plies its strong jaws until a bit of wood is dislodged. Meanwhile, its wings are kept in a state of continual agitation, its abdomen curves and vibrates, and sometimes is turned up at an angle of 45°. Its legs are incessantly lifted and set down, but stiffened out at the moment of dislodging the wood as they are braced for a strong tug. By the time one has well fixed his eyes upon the palpitating creature, it has spread its wings and is away. I follow it at full speed. Once more it alights; it has struck a good spot for collecting material surely!—a fine, whitish, weather-worn patch of wood whose fibres are exposed.

This must be a real bonanza for the wasp! But no! She glides over the rail with fluttering wings, and is off to another place. Her actions, the reasons that seem to determine her choice and final decision are as incomprehensible to me as the proceedings of ladies when on a shopping expedition.

"At last, however, she has gathered a little ball of wood-fibre; she throws herself back upon her two pairs of hind-legs, and standing thus in a semi-erect posture, like a squirrel eating a nut, she adjusts the pellet to her jaws with her fore-paws and flies away with it to the nest. This is fastened to the branches by a central stalk which is firmly tied and pasted on. The stalk is usually directed upward, or somewhat inclined, so that the mouth of the cells is downward. The bottom parts of the cells are thus upward, and as they are united and covered with a paper floor the whole series forms a sort of hanging platform. On this platform a bevy of wasp-workers may usually be seen engaged in chewing up the woody fibres into pulp, or preparing wax for the cell-covers, or grinding up 'pap' for the baby grubs. When the pulp is prepared it is pasted in thin flakes on the ledges of the cells, and spread and shaped chiefly by the action of the mandibles, although somewhat aided by the feet. A secretion from the salivary glands of the wasp, which corresponds with the 'sizing' used by paper manufacturers, helps to bind the fibrous pulp into a compact mass that quickly hardens into a rude but efficient *papier machè*.

"The nests are circular or oval in shape and of various sizes. This specimen is seven inches in diameter, and I have seen one at least one-half larger. The size is determined by the number of young, for each of these cells contains a single larva."

"Tell us, please, how the nest begins," said Abby. "Do the wasps live through the winter?"

"No; the workers all die with the frost; but a few of the females survive the winter. They hide in crannies: for example, under the eaves of your schoolhouse roof, or other sheltered places, and live through the cold months in a torpid state. The warmth of spring summons them from their retreats, and they at once begin the foundation of a family. Having chosen a site they proceed to build a few cells in which they place eggs that in time become larvæ. These are fed by the mother until ready to pass into the pupa stage, when the cells are sealed up, and so remain until the perfect insects emerge. The first born are workers, and at once take upon them the labors of the colony, leaving the queen to her proper duty of furnishing eggs. The nest grows by the addition of cells along the outer margin, into each of which as finished an egg is placed. The old cells also appear to be used, being cleaned out and again furnished with eggs as soon as the younglings are fairly out of the way. Thus the last baby waspling falls heir to the cradle of its predecessor, as is often the case with our own infants."

"What are these snow-white caps that cover so many of the cells?" asked the Mistress. "I notice that

some of the cells are without them—these along the edges."

"The white caps are the 'seals' placed upon the cells when the larvæ spin into pupæ. Observe that many of these caps are quite cut around the edges, showing that the young wasps have cut their way out. This specimen was gathered late in the summer, and as it lay upon a table in my library I could now and then hear the rasping of the wasps' mandibles as they gnawed the seal away, and ever and anon would see a youngling creep out of a cell by pushing up the cap like a lid, and then feebly crawl off and stretch its wings. But most of the inmates died within the cells. Perhaps the dry, warm air of my study was unfavorable to their escape, or they may have needed the jaws of their nurses to aid their egress."

"Are these caps made of paper, too?" asked Hugh.

"No, they are in part a covering which the larvæ themselves spin, and in part, probably, a sort of wax, secreted and applied by the workers, very much as with the wax-workers among bees. I leave you now to study the habits of these ringed wasps for yourselves, when next summer comes, and turn to another insect belonging to the same group of social wasps. Here is a hornet's nest, the most famous of our American paper-makers—*Vespa maculata*."

The specimen, which had been secured by the energetic search of Joe and Harry, was eighteen inches long and a foot in diameter at the thickest part. It was a pear-shaped structure, whose bulkier end was placed

FIG. 138.—NEST OF AMERICAN HORNET. (VESPA MACULATA.)

upward as it hung from a strong branch that was quite wrapped around, and indeed had been somewhat overlaid by the layers of paper which formed the external envelope. At the bottom of the nest was a round opening which formed the only entrance to the interior (Fig. 138). A second specimen, a little smaller, I had cut quite in two by a longitudinal slit, thus exposing the entire structure of the nest.

"Here we may see the whole cunning workmanship of this active insect. You observe that the outer walls have been laid on in several layers or sections, more or less regular, and are composed of a strong, coarse gray paper. The partition walls are united at various points, leaving a great number of oblong air-chambers." (Fig. 139.)

"Is the paper weather-proof?" asked Abby.

"Try it," I said. A pitcher of water and a dish-pan were brought, and after various experiments it was found that the water rolled freely from the roof, which scarcely absorbed the moisture and left the interior quite dry.

"That is truly excellent," remarked Aunt Hannah. "I wonder that some enterprising genius has not borrowed a hint from the hornet and gone to building paper houses."

"And why not?" said the Manufacturer. "We are utilizing paper more and more freely in the civilized arts, and have got even as far as to make railway car-wheels out of it! Paper tiles or roofs, or even walls may surely be considered a possibility."

"Very well," I resumed; "when that triumph is achieved let us moderate our human vain-glory at least so much as to remember that the hornets had by some milleniads the priority of man. Now, look at the inside furnishing of this nest. Here are six separate circles, terraces or stories of hexagonal cells arranged one above another, and united by tough paper stalks or pillars, which are placed at or near the center. Other similar columns are distributed at sundry points along the floor, thus contributing to its support; they are formed of long fibres, and broaden out at each end, where they are attached above and below. Each one of the combs, as they are called, resembles the nest of the ringed wasp, which, you see, differs from the hornet in always building a single comb and never enclosing it within walls."

"Why is this difference?" asked Abby.

"Ah! who will tell us? I have never been able to think of any reason based upon the idea of protection or any other probable necessity which conditions the hornet's life, but from which the wasp is free. It is one of those strange facts which mark the distinct individuality of closely allied species, in accordance with the infinite variety seen in nature, and for which no apparent reason can be assigned."

"Except, perhaps," suggested Aunt Hannah, reverently, "that infinite wealth of thought and skill which one must think to be the natural outcome of an Infinite Creative Mind."

"A just remark, Aunt Hannah; but whatever ex-

planation be suggested, the facts are sufficiently interesting. If you look again at this open nest you will see that the combs increase in size from the top to the center and then gradually decrease until this last of the series, which is a very small affair. The insect, of course, began its nest at the top, and built downward, having just commenced this lower comb when the work of the colony was forever stopped by Jack Frost. This process, you observe, is the reverse of our human modes of building, and probably will never be adopted by us, notwitstanding the ingenious proposal of the Laputan philosopher mentioned in 'Gulliver's Travels' to imitate this peculiar feature in the hornet's architecture by building the garrets of every house first, and then gradually working downward to the lower stories and cellars!"

The laugh which this quaint conceit awakened was interrupted by a remark from the Manufacturer:

"I believe we do sometimes follow the hornet's order. in sub-aqueous architecture, for example, as when we build a bridge pier in mid-stream by caissons. Another example is found in the famous subterranean structures of Rome, known as the Catacombs, which served the primitive Christians not only as cemeteries but as homes and temples as well. But—excuse me!—I do not wish to play the part of Gulliver's philosopher."

"Have I not heard some such theory applied to the building of the Pyramids?" asked Abby. "I do not recall the details, but the author starts out with a quotation from Herodotus who cites a rumor or tradition

FIG. 139.—INTERIOR OF HORNET'S NEST, SHOWING THE "COMBS."

that the great Egyptian edifices were begun at the summit and builded downward. Whether the notion were broached by a savant, a hobbyist or a crank, I do not remember, but it surely has a modern advocate somewhere."

Here Sarah ventured an observation:

"I don't wonder at sich a pesterin' inseck as a hornet buildin' its house top eend fust, or any other contrary way. Fer my part I don't want em buildin' round me nohow! It's certain bad luck to have 'em make ther pesky nests in one's house, an' foretells that the family 'll be sure to come to want. I'd jest like to have the hull lot here in one good bunch; I'd chuck 'em into the stove and be done with 'em!"

"Hi, Sary Ann, dat's no good!" exclaimed Dan, whose tongue was unloosed by the remarks of his kitchen familiar; "Dat's no good at all. Hit's no sort of conjurin' to kill de common brood wen dey's growed up. But dar's a powerful difference wen it comes to the fust wasp ob de season. Hit's mighty good luck to kill dat un, I kin tell ye."

"Well, then, *tell* us, won't you," responded Sarah, with some tartness; "there hain't no wisdom sittin' ther a-rollin uv your head an' turnin' up your eye-balls."

"Sary Ann," answered Dan, "dar's folkses wat has waspish tempers and a hornet's stinger fer a tongue—but dat's needer hyur nor dar. Wat I saze is dat hit's good luck to kill de fust wasp ob de season, kaze it foretells freedom from all enemies fer dat year, shore. Dat's all!"

Sarah was not disposed to yield the point, especially as she was smarting under Dan's keen thrust.

"Pshaw!" she exclaimed, "You culled pussons allez build your idees like a hornet does it's nest, upside down. W'at *I've* heern tell is that the very sight in the house uv the fust wasp uv the season, let alone killin' uv it, is sure to bring bad luck. It's a sign uv an onpleasant 'quaintance, and ther's no good luck in that, *I'm* sure!"

The cook rattled her knitting needles vigorously, and shot a triumphant glance at her venerable antagonist.

But Dan was not to be suppressed thus. Revolving on his cricket, he turned full toward the kitchen door, and assuming a demure expression and subdued tone, replied:

"Now den, Sary Ann, I 'low yo's right dis time. I gibs up de pint. I done remember, jes now, dat one tickler yaar I was so onlucky as to see de fust wasp ob de season; dar was two ob dem in fac'. An' dat was de berry yaar I fust hab de honor to make *yo'* 'quentance, Sary Ann! Ya-as, I guess yo's right dis time."

He resumed his position on the cricket with a solemnity that was not disturbed by the general merriment of our party. The Mistress, however, was plainly not amused. Her face was flushed and drawn into lines of disapprobation, as she turned upon me a glance of remonstrance. Indeed, it was only in the face of many protests that I had been able to carry my purpose to keep the room on Conversation Nights a

"Liberty Hall," wherein all should be held equal and encouraged to the utmost freedom. With most of our domestic circle there had been no embarrassment, but Dan and Sarah had such an irrepressible tendency to carry their kitchen sparring into the conversations that the good housewife was often shocked.

"It will quite overturn my domestic discipline," she affirmed; "and destroy all dignity in our relations with the household helpers. It is preposterous to allow Sarah and Dan such liberties!"

However, this course seemed to me the only one to evoke the peculiar notions that I wished to reach, and which come only with perfect freedom. So the Mistress yielded with what grace she could, although her patience was sometimes sorely tried, as on this occasion. Perhaps, I may here say that the good wife's predictions were not fulfilled, for the spirit of our Liberty Hall evening never seemed to invade the ordinary services of the house and farm. But this may suffice for apology.

"We have not quite finished the natural history of the hornet," I resumed. "Almost as soon as the first cells are formed in the early spring, the building of the nest-covering is commenced. At first it has the appearance of a miniature umbrella, but as the cell-work grows it is expanded and drawn downward until it quite encloses the combs. The larvæ, of course, from the reversed positions of the cells, live head downward, and this posture they are said to retain by means of a gummy secretion at first, and afterward by the swollen

front of the body which fills the open part of the cell. At all events, the little heads are conveniently placed for the nursing workers, who move over the surface of the comb pressing into open baby mouths the nourishing 'pap' which has been prepared for them by the very primitive mode of chewing."

"Does thee know what sort of food this hornet pap is composed of?" asked Aunt Hannah.

"It is probably the juices of insects for the most part. The proper food of hornets, wasps and other Vespidæ is somewhat in doubt. In spring and early summer they feed on the sweets of flowers, but later in the season develop a taste for fruit, and attack strawberries, plums, grapes, pears — even entering houses to help themselves to dishes on the table. But they are carniverous in their appetite also; they will eat raw meat, as you may see by visiting our village butcher shops. They are insectiverous, too, and carry war into the insect world, their weapon not being their sting as with their relations the Mud-daubers and Digger Wasps, but their formidable jaws. They fall upon flies and butterflies, bite off their wings, feet and head and devour the trunk. They even destroy honey-bees, assailing them on their return from the fields laden with pollen. They throw themselves upon their victims, tear the abdomen from the thorax and and suck its contents. I have known persons who have turned this insect-devouring propensity of hornets to good purpose by hanging one of their nests in a house much infested by the common house fly, from

which, I have been told, they soon make a thorough riddance of the annoying insects."

This touched upon Sarah's department, and she expressed her interest by saying: "I kin vouch fer part of them facts, anyway. The hornet's do ketch flies, I'll say that much for the pesky critters. I've often seen 'em pitch through the kitchen winders like mad, bounce upon the flies and clear away with them. But lawsamassy, ther haint no one goin' to get out a patent on that kind uv a fly trap! Fer who'd want sech a reglar hostyle sallyport es that around, I'd like to know? I reckon the remedy 'd be wuss 'n the cure."

"I can't speak from observation," I responded, "but I have been told that the experiment brought no inconvenince; that as long as the hornets were not meddled with, they molested no one. This much I can say, that in my numerous field excursions, I have never been meddled with by the stinging insects except when I gave them some provoking cause. However, I have no zeal to prove the usefulness of the hornet or press it into duty as a servant of man. But we wander from the point which I started to explain concerning the food of wasps. It is an open question with entomolologists whether all the insect food thus captured is used for the nurture of the larvæ, or whether it is partly appropriated to the creatures' own use. I do not venture an opinion on the subject."

"They do say," remarked Hugh, returning to the point of usefulness, "that the smoke of a burned hornet's nest is useful. I've heerd horsemen say that it 's

FIG. 140.—WASP'S NEST WITH TUBULAR ENTRANCE.
(ONE HALF NATURAL SIZE.)

good fer distemper, but I never tried it myself. Ther's a sayin' too, w'ich I larnt w'en a boy that they 're weather-wise and kin foretell w'at kind of a winter we're goin' to hev. It runs this a-way:

> 'If hornets build low,
> Winter storms and snow;
> When hornets' nests hang high,
> Winter mild and dry.'

Howsomever, I reckon ther's not much in that forecast, kase the varmint seem to take it pretty much as it comes, some high, some low, in the same season. I don't count so much on them sort uv sayins as I used to; though insecks is powerful wise critters in many things, I allow."

"Are the hornets spoken of in Scripture (Josh., 24. 12, Deut. 7, 20) the same insects as ours?" asked Aunt Hannah.

"The Bible hornet is probably the common European species, *Vespa crabro*. It is quite like our own species in habits, but prefers to build in a hollow tree or similar site. It has been naturalized in America, and I have specimens of its combs from New Jersey. But our evening is quite worn away, and we must close this Conversation. Before we do so, however, I call your attention to this pretty nest, which somewhat resembles the hornet's. It is much smaller, being about the size and shape of a Bartlett pear. I found this specimen in a low bush by the roadside just beyond our farmhouse. Its chief peculiarity is this tube about half an inch in diameter which forms the entrance or vesti-

bule to the nest interior. The tube varies in length—I have seen one six inches long. I know nothing of the habits of the little architect, but greatly admire the skill with which it shapes its paper nursery and domicile." (Fig. 140).

Good-nights were then said, and as our friend the Manufacturer left he expressed a hearty satisfaction and pride in his mute fellow-craftsmen of the insect world, and gave a warm invitation to visit his mill, and compare his methods of paper making with that of the wasps and hornets. The invitation, by the way, was accepted, and the whole party had the pleasure of making a tour of the factory under the personal conduct of the proprietor. The visit had an interest which was much keener and more intelligent because of our evening companionship with Nature's first paper makers.

CHAPTER XXII.

NEW TENANTS AND OLD FRIENDS.

As I close these reminiscences I find myself wondering on what principle the subjects here presented have been selected? Somewhat at haphazard, no doubt. I am sure, at least, that the Conversations which I have written out by no means embrace the most interesting material. But where all is so full of interest, who will criticise my choice or censure my omissions? When I look over my notes I see among the themes which engaged us such as these: "The Carpenter's Company"—relating to wood-working insects, as the Carpenter ants and bees; "The Venerable Order of Undertakers," relating to the burrowing beetles and necrophagous insects; "The Ancient Mariners," who gave us a pleasant evening with water insects; "Living Lamps," such as the lightning-bug and glow-worm; "Insect Pets and Domestic Herds;" "Kidnappers and Slaves," a story of the slave-making ants; "Squatter Sovereignty," the mysterious history of insect parasitism; "The Tyrant of Two Elements," a history of dragon-flies; "The Summer Tourist's Pest," an account of the musquito and its allies; "The Evolution of a Silk Gown," which canvassed the life of the silk-worm. These are a few of

our subjects; I will enlarge the list no further lest some unpitying publisher should be enamored of it, and lure me to write another book! The Conversations were prolonged far into the summer, and had a new element of interest in the fact that we could follow our insect friends to the fields and ply our study of their curious habits there.

At last the time came to close our pleasant conferences. The prescription of the medical man had this time, at least, wrought a cure. Rest, change of scene and habit, life in the pure country air, gave tone to shattered nerves, and brought once more the joy of health. Our year's lease of the Old Farm expired as the golden days of October fell upon the landscape. It was not without pain that we bade adieu to our rural friends and returned to the city. Our hearts had sent out many strong rootlets around the Old Farm which we were loth to break. But we left new tenants in the dear old place, and that comforted us. Shall I tell who the tenants are?

Love, which breaks through iron bars, can prevail even over the stronger barriers of religious prejudice. It was long before Aunt Hannah gave way, but at last she bowed to the inevitable, and Penn Townes married Abby Bradford. It was agreed that Penn would not forsake the Meeting, even though he should be "turned out," and that was some mitigation of the good woman's trial. There was one condition which the Mistress and I had named that was at length conceded. The young people were married at the Old Farm just

before we ceased to be its Tenants. Dr. Goodman officiated, and a happier evening never brightened within the venerable walls than that which saw the consummation of so fitting a union.

A voice at my side has just said : "Tell them something about all the rest, dear. People do love to hear what becomes of the folks in whom they are interested ?"

It is the Mistress who speaks, older in years, indeed, but young as ever—younger than ever in the vigor and charm of that love whose devotion is the sweetest remembrance of those invalid days at Highwood.

Well, then, for the Mistress' sake, if not for the reader's, I will write the chronicle, which is neither long nor eventful.

The last time that I visited the Old Farm was to attend a "house-warming," given on the occasion of Penn Townes entering into possession of the place, which he had bought. Thus, after years of alienation, it had come back to the family who reclaimed it first to civilization. The event was an auspicious one, and well deserved celebration. What a royal time we had with kindred and neighbors, old and young !

Abby, grown quite matronly, presided with that characteristic animation which marked her earlier years. Her fine brood of younglings thrive in the country air. The oldest bears the name of Hannah, a peace offering, or, perhaps, I should say a thank-offering to good Mother Townes. The second, a sturdy lad, is proud to be called Fielding Mayfield Townes ;

and somewhere in the series there is a little blue-eyed Kate, a namesake of the Mistress.

"Was Penn cut off from membership for marrying out of Meeting?"

No; he is still "in good standing," at least in so far that he has not been formally "turned out." But if you ask me why, I can give you no light beyond the facts; perhaps the subject is still under consideration by the Society. Be that as it may, there are few more regular worshipers at the Springfield Meeting House than Penn Townes, and when family duties will allow, Abby finds great pleasure in accompanying her husband, especially as the traditional "scuttle" bonnets have long since been eschewed by the younger women Friends. The elder children also are sometimes taken; but such fidgeting as attacks the dear bairns during the solemn quietude that often pervades the Meeting is pitiful to see. To the mind of some of the stricter Friends, it seems something very like a temptation of the Adversary. But the major part, perhaps correctly, attribute it wholly to Friend Abby's stirring Yankee blood.

Hugh has left the tenant house and occupies a farm of his own. Jenny lives at home, a soldier's widow. Joe marched off Southward in the rebellion days with a "Springfield rifle" on his shoulder—that weapon, by the way, was *not* named after our old Quaker Meeting-house—and returned with a major's golden leaf upon his shoulder-straps. And well he deserved the honor, his comrades all declare. Harry went into my count-

ing-house, and some day soon will be the head of the firm. He developed a strong taste for entomology, is an active member of the Academy of Natural Sciences, and a good authority in the American Hymenoptra.

"Tell them what became of Sarah," the Mistress said, prompting me as I paused in my narrative. "In spite of her superstition and sharp tongue, I am sure she has some friends among your readers."

Oh, to be sure. There is a spice of romance in her story, too. Sarah's 'matrimonial wentur,' as she was wont to call him, turned up at last, and despite his long desertion, was welcomed and received by the faithful cook. Tom had been a member of a Colorado battery during the war, had saved most of his wages, gathered no end of good sense by his experience, and being thoroughly homesick, came back East. He found Sarah still officiating in the Old Farm kitchen under the new regime and the two 'tuk up agin',' to use the quaint phrasing of the country-side. When Hugh vacated the tenant-house, the re-mated pair moved in, and there they dwell. Sarah has learned something as well as Tom, and carries a less waspish tongue than in earlier days. However, she has never given up her fancy for the conch-shell, and winds its rude notes at noon and evening with a never-failing gusto.

"Old Dan now," said the Mistress. "You musn't forget him."

Forget old Dan? No! I have received too much genuine comfort from that odd patriarch to omit him

from this chronicle. I last saw him on the occasion of the house-warming to which I have alluded. He spends his summers at the Farm, as a sort of family pensioner, and busies himself with such light chores as he takes a fancy to. He was engaged that day in a large potato field just across the lane in the congenial work of killing potato beetles. The story of that service is worth telling.

"Mars Penn," said Dan, "w'y doan yo do suthin' 'nother to kill dem tater bugs? Dat patch 'll be clar cleaned out less yo do. Hit's done ruined now, nigh-amost."

"There's no use trying any more, Dan," was the answer. "I've spent already more time and money than the whole field 'll bring. I shan't try any more. The bugs are too much for us. Let the plaguey things have the potatoes; they 're bound to, anyhow."

"Now den, Mars Penn, dat's jess too bad," responded the negro. "Jess yo' lem'me try em onct. Gimme some Paris-green, and we'll see w'at ole Dan'll do wid dem pesky critters. We'll fix em yit! Ho, ho! nebber seed de bug dat got ahead ob old Dan! Hi, yi!"

The Paris-green was provided, and Dan was set to work, more to satisfy him than from any hope that he would be of real service. From that time on he gave his undivided attention to the "tater patch." Early in the morning when the dew was on the field, he was seen powdering the leaves of the infested tubers with the poison. During the day he continued the assault

with his tin pan, knocking the larvæ therein and bearing away quantities to the kitchen door to become the victims of boiling water, furnished by Sarah.

By-the-way, the two old antagonists still continue their intellectual sparring and chaffing, but withal are very good friends. Many a tit-bit the cook saves for the old man, and the warmest nook by the kitchen stove is his.

As Dan went about his daily work of slaughtering Colorado beetles, he kept up a running series of ejaculations, mingled vauntings, and mild imprecations. Often he laughed softly as he slowly moved along crooning and talking to himself. The warfare with the bugs had raised his spirits, evoking the element of combativeness, and inspiring him with new vigor. But age is telling sorely on him, and rheumatism has added to the weight of years to bow his back very much. I leaned upon the fence and watched and listened to him as he approached the end of a row of plants.

"Hi, den! Yo' jess go inter dat pan!" knocking off a score of insects, in various stages of development. "Plenty of company dar, now, but not much to eat, hey? Well, I'll git you sumpin to drink, bymeby! Ho, ho, ho! Tea?—no! Tater soup?—not much! Yo' got too much ob dat aready. Hot water, sah! Bilin'!—ho, ho! So yo' thot Dan couldn't circumwent tater bugs? We'll see boout dat! Bugs?—hi! I knows a heap more'n yo' tink boout *dem*, I kin tell yo'. I done gradewated long go. Reglar colledge larnt—ho,

ho, ho! Now, den, dat row's done, and de pan's boout full. Take 'em off to Sary Ann. Mebbe she want's 'em for bug soup! Hi! House warmin'? Yes, sah! I reckon ole Dan'll give dese yur gemmin a reglar old-fashioned one; no mistake boout dat!"

As he shuffled along, he gazed into the pan with a radiant look, and skimmed the edges with his gray, knobby hand to push back the crawling insects. Thus busied he was passing me quite unnoticed.

"Hello, there!" I called.

Dan looked up suddenly, then hobbled up to the fence, laid down the pan, and reaching out both hands gave me a hearty greeting. But the reader will not be concerned with our talk, and I shall only state the issue of the conflict with the beetles before bidding Dan good-by.

"I sold a thousand bushels of potatoes off that field," said Penn Townes, whom I met in the city one day the next winter. "If it hadn't been for old Dan's determined fight, I wouldn't have got as many as I planted."

The old man is living yet, and, for aught I know, is fighting potato beetles on the Old Farm even while I write these lines.

There is one more friend whose memory craves a passing word. I drove one Sabbath day this summer to the Marple Church. The birds were warbling in the trees that skirt the churchyard; the grasshoppers were shrilling from the waving verdure that grows rank among the graves; little children were wandering

among the tombs in their bright Sunday dresses; and in one corner, close by the road, a rustic couple were standing by two marble stones, spelling out slowly the inscriptions thereon. I drove my horse close to the fence, and uncovering my head, joined the countryman and his wife in their homage at the grave of Dr. Goodman and his wife. Twin headstones, precisely alike in form and finish, mark the respective places of rest. At the top of the stone which marks the wife's grave are the words:

"THE MORNING COMETH."

In like position at the top of the Doctor's monument is the inscription:

"A MORNING WITHOUT CLOUDS."

The eye glances from one to the other, and the separate mottoes read as one sweet, suggestive sentence, "The morning cometh"—"A morning without clouds."

Even so, dear friends, even so be it for us all!

Beneath the beloved name of pastor, husband, father, friend, is carved a text of Holy Scripture, never more fitly used in the elegiac inscriptions of churchyard, aisle and vault:

"They that be wise shall shine as the brightness of the firmament; and they that turn many to righteousness as the stars for ever and ever."

[THE END.]

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